CDM

Final
Feasibility Study for Onsite Soils

Omega Chemical Superfund Site

Whittier, California

May 21, 2008

Prepared for:

Omega Chemical Site PRP Organized Group

Prepared by:

CDM
111 Academy, Suite 150
Irvine, California 92617

Project No. 10500-37240-T2.OSS.FS

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May 21, 2008

Mr. Chris Lichens
Remedial Project Manager
U.S. Environmental Project Manager Agency-Region IX
75 Hawthrone Street (SFD-7-4)
San Francisco, CA 94105

Re: Final Feasibility Study,
Omega Chemical Superfund Site, Whittier, California

Dear Mr. Lichens:

Enclosed is the final Feasibility Study (FS) for the Omega Chemical Superfund Site. This final FS is submitted in accordance with the February 2001 Consent Decree.

Should you have any questions, regarding the above, please contact me.

Sincerely,
Omega Chemical Site PRP Organized Group

Edward Modiano

Edward Modiano
Project Coordinator

Cc: Tom Perina, CH2MHIL
Lori Paranass, DTSC
Dave Chamberlin, CDM
Sharon Wallin, CDM

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List of Acronyms

ARARs - applicable or relevant and appropriate requirements

ASR - annual status reports

BACT - best available control technology

Basin Plan - Los Angeles Regional Water Quality Control Plan

Cal/EPA - California Environmental Protection Agency

Cardinal - Cardinal Environmental Consultants

CCR - California Code of Regulations

CDM – Camp Dresser & McKee Inc.

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CFR - Code of Federal Regulations

CHHSLs – California Human Health Screening Levels

COC – chemicals of concern

COPC – chemicals of potential concern

CWA - Clean Water Act

DCA - dichloroethane

DCE – dichloroethene

DHS - Department of Health Services

DPE – dual phase extraction

DTSC – Department of Toxic Substances Control

DWR - California Department of Water Resources

ECHOS - Environmental Cost Handling Options and Solutions

EECA - Engineering Evaluation/Cost Analysis

England & Hargis - England & Associates and Hargis + Associates

EPA - U S Environmental Protection Agency

ERH - electrical resistance heating system

ESA - Environmental Site Assessment

FS - Feasibility Study

GRA - general response actions

H&SC - Health and Safety Code

Hg - Mercury

HHRA – Human Health Risk Assessment

HSWA - Hazardous and Solid Waste Amendments

ICs - Institutional controls

LDR - and disposal restrictions

mg/kg - milligrams per kilogram

MCL – maximum contaminant level

MCLG – maximum contaminant level goal

MIP – Membrane Interface Probe

MSL – mean sea level

NCP - National Oil and Hazardous Substances Pollution Contingency Plan

NELCO - New England Lead Burning Company

NPL - National Priorities List

NTCRA - non time critical removal action

OPOG - Omega Chemical Site PRP Organized Group

OSHA - Occupational Safety and Health Administration

OU - operable unit

PCE - tetrachloroethene

PPE - personal protective equipment

PRGs – Preliminary Remediation Goals

ppmv - parts per million volume

PRP - Potentially Responsible Party

OU - Operable Unit

RAGS - Risk Assessment Guidance for Superfund

RAO – remedial action objective

RCRA - Resource Conservation and Recovery Act

RI - Remedial Investigation

RWQCB - Regional Water Quality Control Board

SARA - Superfund Amendments and Reauthorization Act

SCAQMD - South Coast Air Quality Management District

SCFM – standard cubic feet per minute

SDWA - Safe Drinking Water Act

Site - Omega Chemical Superfund Site

SSD - sub-slab depressurization

SVE - soil vapor extraction

SVOC - semi-volatile organic compounds

T-BACT - best available control technology for toxics

TCA – trichloroethane

TBC - to be considered

TCE – trichloroethene

TDS – total dissolved solids

TIP - technology innovation program

TM – Technical Memorandum

TSDF - treatment, storage, and disposal facility

TSCA - Toxic Substances Control Act

USC – U.S. Code

UST - underground storage tank

WDR - Waste Discharge Requirements

WQO – water quality objective

WRR - Water Reclamation Requirements

VGAC – vapor phase granular activated carbon

VOC - volatile organic compound

μg/m3 - micrograms per cubic meter

Executive Summary

Camp Dresser and McKee Inc. (CDM) prepared this feasibility study (FS) report for the Omega Chemical Superfund Site (site), Operable Unit (OU) 1 on behalf of the Omega Chemical Site Potentially Responsible Party (PRP) Organized Group (OPOG). OU-1 includes the former Omega Chemical property and the immediate vicinity. This report was prepared in accordance with Task 2 of the Statement of Work (SOW) in *Consent Decree No. 00-12471 between the United States Environmental Protection Agency (USEPA) and OPOG* (USEPA, 2001). The Consent Decree was lodged on November 24, 2000 and entered into the US District Court on February 28, 2001. This FS develops, screens, evaluates, and compares potential soil remedial alternatives at the site.

The Omega facility provided treatment of commercial and industrial solid and liquid wastes and a transfer station for storage and consolidation of wastes for shipment to other treatment and or disposal facilities. The California Department of Toxic Substances Control (DTSC) requested assistance from USEPA to conduct a site assessment in August 1993. The site assessment inspection revealed that approximately 2,900 drums of hazardous waste were at the Omega Chemical property in weathered condition, but not completely corroded nor leaking. These drums were subsequently removed from the property.

According to the *Phase II Close Out Report* prepared by England & Associates and Hargis + Associates (England & Hargis) in 1996, Omega Chemical Corporation operated the facility for recycling and treatment of spent solvent and refrigerant. Drums and bulk loads of waste solvents and chemicals (primarily chlorinated hydrocarbons and chlorofluorocarbons) from various industrial activities were processed to form commercial products. Eleven treatment facilities were present in 1990. The majority of these treatment units were located in the general area of the warehouse loading dock.

Task 2 of the SOW required OPOG to perform a vadose zone Remedial Investigation/ Feasibility Study (RI/FS) and Human Health Risk Assessment (HHRA) for On-Site Soils. During implementation of the RI, soil, soil gas, and air (both indoor and ambient) samples for laboratory analysis were collected during several phases of investigation. A total of 44 volatile organic compounds (VOCs) were detected at least once in the soil vapor samples. PCE is the most widespread compound at the site. Other compounds are present at high concentrations and are widely distributed, but not to the extent of PCE (e.g., Freons -both 11 and 113; trichloroethene [TCE]; 1,1,1-trichlorethane [1,1,1-TCA]; 1,1-dichloroethene [1,1-DCE]; and cis-1,2-dichlorethene [cis-1,2-DCE]).

The contaminants, which primarily consist of volatile organic compounds (VOCs), present in the subsurface at the former Omega Chemical property, may have been released via one or a combination of the following mechanisms:

- Leaking above and/or underground storage tanks and associated piping; historical information suggests that such potential sources are most likely on the northern and northwestern portion of the former Omega Chemical property (see Figure 2-1 which illustrates the locations of historical tanks and the loading dock area)

- Transport of on-site surface spillage (e.g., from above ground tanks, drum storage areas, poor housekeeping practices, etc.) over pavement to unpaved areas with subsequent infiltration; these types of releases may have occurred anywhere on the former Omega Chemical property and may also have been transported via surface runoff onto directly adjacent properties (e.g., Terra Pave).

- Leaking drums, particularly those which were located in the northern and northwestern portion of the former Omega Chemical property

The total VOC analytical results for shallow soil vapor samples indicate that the areas with highest VOC concentrations in the shallow vadose zone are primarily located at the former Omega Chemical property. Figure 1-2 illustrates the location of the former Omega Chemical property and other properties in the general vicinity. In general, VOC concentrations above approximately 30 feet below ground surface decrease to the south and southwest of this location. Soil vapor VOCs to the east, along Whittier Blvd., were relatively very low in shallow soil vapor samples. Deeper vadose zone soil vapor VOC concentrations are also high between the Star City and Medlin buildings, and are also high near the Terra Pave building and the Bishop building. Moderate total VOC concentrations were present in >30 foot soil vapor samples collected from a location southeast of Skateland and to the southwest of the Medlin building. As for the shallow vadose zone results, soil vapor VOCs to the east, along Whittier Blvd., were relatively very low in >30 foot samples.

Remedial action objectives (RAOs) are medium-specific or site-specific objectives for protection of human health and the environment. Each RAO should specify the contaminants of concern, exposure routes and receptors, and the desired preservation or restoration of an environmental resource. The Human Health HHRA defined the specific levels at which contaminants no longer pose a human health or exposure risk. As such, these risk-based values (the site-specific preliminary remediation goals [PRGs]) provide a numerical standard that each remedial alternative developed in the FS must obtain to be considered protective.

The following RAOs have been developed for the contaminated onsite soils:

- Reduce or eliminate the vapor intrusion risk associated with VOC vapors in contaminated soils

- Reduce or eliminate the risk associated with direct exposure to, contact with and/or ingestion of contaminated soils

- Reduce or eliminate contaminant migration to groundwater to levels that protect the groundwater resource

The first two RAOs will be achieved by reducing VOC concentrations in soil and soil vapor to site-specific Preliminary Remediation Goals (PRGs), based on future residential land use, in the Final HHRA for On-Site Soils (CDM, 2007).

The third RAO will be achieved by reducing soil and soil vapor concentrations to levels that will be protective of the highest beneficial use of the aquifer; these specific cleanup levels will be determined during Remedial Design. In the event that the final groundwater remedy covering OU-1 does not require cleanup to achieve the aquifer's highest beneficial use, the cleanup levels for soil with respect to the third RAO will be revised to be consistent with such final groundwater remedy.

Site-specific PRGs were defined in the HHRA for On-Site Soils (CDM, November 9, 2007) for the COCs. The site-specific PRGs are the acceptable risk based levels that quantitatively define the RAOs.

PCE is the most widely distributed COC onsite, and in fact, for each location where there is a non-PCE site-specific PRG exceedance there is also a site-specific PRG PCE exceedance. Therefore, the volume of the subsurface that requires remediation has been defined as that area where there have been site-specific PRG exceedance for PCE in soil or soil vapor.

As described above, the RAOs are for the soil remedy only. Although on of the RAOs is to achieve contaminant levels in soil that are protective of groundwater, the soil remedy alternatives evaluated for the site do not directly involve groundwater remediation. Thus the soil remedy is not intended, in and of itself, to restore groundwater. In 2005, EPA selected an interim groundwater remedy (containment) for the OU-1 area and will soon be evaluating cleanup alternatives for the groundwater plume downgradient of OU-1.

The FS process begins with screening remedial technologies and process options with regard to site conditions and the site contaminants. To address the OU-1 soil contamination, four remedial alternatives were developed from the list of retained technologies and process options and then compared using seven criteria in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (USEPA, 1980). The purpose of the alternative analysis is to present the relevant information that decision makers need to select a remedy for onsite soils. These alternatives are:

- Alternative 1 - No Action
- Alternative 2 -Soil Vapor Extraction (SVE)/Partial Capping/Institutional Controls (ICs)
- Alternative 3 - Hot Spot Excavation/SVE/Partial Capping/ICs

- Alternative 4 – Thermally-Enhanced SVE/Partial Capping/ICs

There are several methods that can be used to enhance the performance of the SVE systems in Alternatives 2 and 3 if it appears the cleanup goals may not be achieved in a timely manner. These would most likely include hot air injection and dual phase extraction (DPE). As a contingency, cost estimates for two of the more likely enhancements (hot air injection and DPE) have been prepared and included in the cost spreadsheets in Appendix A.

If, after system optimization, the post-rebound VOC concentrations remain above the site-specific residential PRGs (as defined in the HHRA) for soil gas in the upper 30 feet, or above cleanup levels that protect groundwater in the lower 30 feet, then enhancements to the SVE system, potentially including hot air injection and/or DPE would be implemented. The enhancements would be implemented for the entire system or at a targeted area, but at a minimum at the wells that triggered the enhancement installation.

If VOC concentrations remain above the site-specific PRGs after initial enhancement is implemented, and data demonstrate that significant vapors are derived from volatilization from groundwater, then additional enhancements, potentially including DPE would be implemented.

Alternative 3 (Hot Spot Excavation/SVE/Partial Capping/ICs) ranked lower than Alternative 2 due the implementability issues associated with the hot spot excavation in the vicinity of existing buildings. Alternative 3 was also slightly higher in cost than Alternative 2 due to the expense of excavating the hot spot soils and the subsequent transportation, treatment and disposal of excavated soils at a Class I landfill.

Alternative 4 (Thermally-Enhanced SVE/Partial Capping/ICs) would remediate the soils in a shorter timeframe than Alternatives 2 and 3 (1.5 years compared to 5.5 years); however, there was considerable cost associated with the time savings ($16.0 million compared to $5.9 and $8.9 million). In addition, there are significant implementation issues associated with Alternative 4 which contributed to a lower ranking compared to Alternatives 2 and 3.

Alternative 2 was ranked high in performance relative to the overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, and reduction of toxicity, mobility or volume through treatment. In addition, Alternative 2 was ranked moderate in cost relative to the other alternatives. It is therefore recommended by OPOG as the preferred alternative.

Section 1 Introduction

1.1 Purpose and Organization of Report

Camp Dresser and McKee Inc. (CDM) prepared this feasibility study (FS) report for the Omega Chemical Superfund Site (Site), Operable Unit (OU) 1 on behalf of the Omega Chemical Site Potentially Responsible Party (PRP) Organized Group (OPOG). This FS develops, screens, evaluates, and compares potential remedial alternatives that address contaminated soils clean up at the former Omega Chemical property as well as adjacent and nearby properties where the underlying vadose zone has been impacted by contamination derived from the former Omega Chemical property..

This FS report was prepared in accordance with the *Guidance for Conducting Remedial Investigation and Feasibility Studies under Comprehensive Environmental Response Compensation and Liability Act (CERCLA)* (United States Environmental Protection Agency (USEPA, 1988), *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Section 1.2 of this report contains background information on both the site description and site operating history. Section 2 provides a summary of the nature and extent of contamination. Section 3 presents a discussion of the Human Health Risk Assessment (HHRA) for On-Site Soils (CDM, November 9, 2007) findings and the chemicals of concern (COCs) for the site. Potentially applicable or relevant and appropriate requirements (ARARs) and remedial action objectives are also presented in this section. Section 4.0 discusses and screens various general response actions (GRAs) and process options that can be considered for use in mitigating exposure to the COCs. Preliminary remedial actions are also developed in this section. Section 5 outlines the criteria and the results of the screening of these alternatives. Sections 6 and 7 outline the criteria used in the detailed analysis of alternatives and the results of the analysis itself.

1.2 Site Background Information

1.2.1 Site Description

OU-1 of the Omega Chemical Superfund Site encompasses the former Omega Chemical property and an area approximately 100 feet southwest of Putman Street, Whittier, California, referred to as the "Phase 1a area" (Figure 1-1). The former Omega Chemical property, located at 12504 and 12512 Whittier Boulevard, Whittier, California occupies Los Angeles County Assessor Tract No. 13486, Lots 3 and 4 a. The Omega Chemical property is approximately 41,000 square feet in area (200 feet wide x 205 feet long), which is just less than 1 acre. Two structures, a former warehouse (now leased by Star City Auto Body) and a former Omega Chemical administrative building (the former 3 Kings Construction) measuring approximately 140 by 50 feet and 80 by 30 feet, respectively, comprise about one-quarter of the site. A loading dock is attached to the rear of the warehouse. The exterior areas of the property are concrete-paved and the property is secured with a perimeter fence and locking gate. Figure 1-1 provides the general location of the site and Figure 1-2 provides additional information regarding the vicinity of the site.

In addition to the former Omega property, OU1 includes one industrial property immediately adjacent to the former Omega property. The Terra Pave, Inc. facility is located at 12511 East Putnam Street, adjacent to the southwestern boundary of the former Omega property.

The selected remedial action will target the zone of vadose zone contamination shown by Preliminary Remediation Goals (PRG) and California Human Health Screening Level (CHHSL) exceedances in Figures 5-1, 5-2, 5-5, and 5-6 of the *Final On-Site Soils Remedial Investigation Report* (CDM, November 9, 2007).

1.2.2 Omega Chemical and Adjacent Property Operations History

1.2.2.1 Omega Chemical Property

The Omega facility provided treatment of commercial and industrial solid and liquid wastes and a transfer station for storage and consolidation of wastes for shipment to other treatment and or disposal facilities. Limited information regarding volumes and types of wastes handled by the Omega Chemical Corporation was available for review. A *Phase II Close Out Report*, prepared by England & Associates and Hargis + Associates (England & Hargis) in 1996, summarized available site information for the period from 1985 through mid-1996, as well as background information (ownership and operational history, geology, hydrogeology, etc.).

According to the *Phase II Close Out Report*, Omega Chemical Corporation operated the facility for recycling and treatment of spent solvent and refrigerant. Drums and bulk loads of waste solvents and chemicals (primarily chlorinated hydrocarbons and chlorofluorocarbons) from various industrial activities were processed to form commercial products, which were returned to generators or sold in the marketplace. An Operation Plan, prepared by Omega Chemical Corporation in 1990 for proposed expansion of the facility, provided a summary of current and proposed facility processes, tank capacities, incoming and facility-generated waste stream characteristics, and handling practices, etc.

Eleven treatment facilities were present in 1990. The majority of these treatment units were located in the general area of the warehouse loading dock. The Operation Plan listed the following storage facilities (see Figure 2-1 which illustrates the layout of the current buildings and the locations of former tanks, sumps, and pits at the former Omega facility):

- Storage Tanks A through F – six stainless steel tanks with 10,000-gallon storage capacity per tank.

- Miscellaneous Named Tanks – 16 stainless steel tanks (Heidi, Jenny, Elaine, Amy, etc.) with the following storage capacities: 1 x 5,000 gallon, 1 x 3,500 gallon, 4 x 2,000 gallon, 1 x 1,300 gallon, 1 x 1,200 gallon, 3 x 750 gallon, 1 x 650 gallon, and 4 x 500 gallon.

- Storage Tanks 1 through 5 – five carbon steel tanks with 5,000-gallon capacity per tank.

The combined storage capacity of the 27 tanks present at the facility in 1990 was 109,400 gallons. Storage tanks A through F were arranged in an L-shaped pattern in the southern corner of the site. Storage tanks 1 through 5 were located in the northern yard, and were arranged in a linear pattern along the side of the warehouse. The locations of the smaller storage tanks were not indicated in the Operation Plan. The Operation Plan states that the 5,000- and 10,000-gallon storage tanks were used to store solvent wastes prior to distillation. Distillation units had a total treatment capacity of 1,500 gallons per hour. The wiped film evaporation units had a design treatment capacity of 200 gallons per hour.

Wastes accepted by Omega Chemical Corporation for recycling were broadly characterized as organic solvents and chemicals, and aqueous wastes with organic waste constituents. Sources of the incoming waste were generated by a wide assortment of manufacturing and industrial processes (petroleum refining, rubber and plastics, chemicals, paper and allied products, furniture and fixture products, lumber and wood products, printing and publishing, textile mill products, food and kindred products, etc.).

Typical types and volumes of wastes generated by Omega Chemical Corporation consisted of the following: C6 to C11 aliphatics (43.4 percent), xylene (16 percent), toluene (7.2 percent), C9 to C10 alkyl benzenes (5.2 percent), isopropyl alcohol (5.1 percent), and a variety of other compounds. Hazardous wastes manifested offsite from the Omega facility during 1989 consisted of the following: 19,300 gallons of aqueous solutions with total organic residues less than 10 percent (Department of Health Services (DHS) Code 134); 1,600 gallons of halogenated solvents (DHS Code 211); 47,245 gallons of still bottoms with halogenated organics (DHS Code 251); 665,000 gallons of other bottom wastes (DHS Code 252); and 120 tons of other organic solids (DHS Code 352).

The Operation Plan states that the Omega Facility maintained 11 treatment units comprised of distillation columns, reactors, wipe film processor, liquid extractor, and a solid waste grinder. The facility also maintained 22 stainless steel tanks with capacities ranging from 500 to 10,000 gallons, and five carbon steel tanks with capacities of 5,000 gallons.

Two inactive sumps are located in the warehouse loading dock area. One sump is rectangular (19 feet long x 5.5 feet wide x 5 feet deep) and the second sump is square (6 feet long x 6 feet wide x 6 feet deep). The roof in the loading dock area is in poor repair, allowing rainwater to collect in both sumps. A composite aqueous sample was collected from the sumps on July 11, 2000. Based on analytical results from the sample, the accumulated rainwater (945 gallons) was removed from the sumps on August 23, 2000 using a vacuum truck. The sumps were pressure washed and fluids were transported under Non-Hazardous Waste Manifest to the Demenno/Kerdoon facility in Compton, California for recycling. In order to prevent future accumulation of rainwater in the sumps, both sumps were backfilled with a sand slurry concrete mix.

From approximately 1999 through 2001, the warehouse was leased by a tenant (Mr. Nicholas Stymuiank) who occupied the warehouse and stored miscellaneous equipment and materials in the warehouse and service yards. The warehouse was converted for use in 2001 by a new tenant (Star City Auto Body) for auto body repair. The former administration building is currently unoccupied; however, the exterior lot adjacent to the building is currently being used by a third party for repair and storage of wooden pallets.

1.2.2.1.1 Property Ownership

A summary of property owners/operators of the site is provided below:

- Late 1930s - property was undeveloped or used for agricultural purposes
- 1951 - property developed, office and warehouse are constructed for Sierra Bullets. During operation of the Sierra Bullet facility, a 500-gallon underground storage tank (UST) was utilized for storage of kerosene.
- 1963 through 1966 - property purchased and occupied by Fred R. Rippy, Inc.
- 1966 through 1971- property used to convert vans to ambulances
- 1971 through 1976 - property occupied by Bachelor Chemical
- 1976 - Omega Chemical (Mr. Dennis O'Meara) purchases Bachelor Chemical Processing (northwestern half) and assumes the property lease from Rippy.
- 1987 - Omega Chemical purchases the leased parcel and adjoining southeastern section from Rippy
- April 11, 1991 - Omega ordered by the Superior Court of the County of Los Angeles to cease operation, remove all hazardous wastes, and close the facility
- September 1991 - Omega files Chapter 11 bankruptcy, which was dismissed on September 7, 1993
- Early 2000s - property was acquired by Van Owen Holdings and divided into two portions for lease

1.2.2.2 Terra Pave Property

The Terra Pave property was formerly owned by the New England Lead Burning Company (NELCO), which operated the site beginning the in mid-1950s. According to the *Phase I Environmental Site Assessment* (ESA) (Cardinal Environmental Consultants (Cardinal), 1991) NELCO purchased lead in sheets, pipe, and solid rods for miscellaneous fabrication operations which involved burning (welding) this lead into various shapes. There are two buildings on the Terra Pave property, Building 1, a two story concrete-block structure used for offices, warehousing and carpentry and Building 2 which was used for welding activities.

NELCO utilized the exterior of the property for storage of equipment and loading materials or finished good for shipment. The ESA noted that undeveloped portions of the property consisted of exposed soil and miscellaneous rubble. Drainage patterns incised in the soil were observed trending in a southerly direction towards Putnam Street.

The ESA also noted that NELCO has subcontracted a cleaning of the interior of all facilities and removal of superficial lead from the topsoil. Subsequent dust wipes and soil samples collected by Cardinal confirmed low remaining lead levels; however, the data supporting this conclusion were unavailable for review.

1.2.2.3 Former Skateland Property

The former Skateland facility was located at 12520 Whittier Boulevard, adjacent to the southeastern boundary of the former Omega Chemical property. The property consisted of an indoor roller-skating rink that was in operation from the 1950s until OPOG purchased the property on October 1, 2006.

Analysis of indoor air samples collected from the former Skateland property resulted in substantial additions to the remedial investigation (RI) scope of work. The initial scope of work consisted of indoor air and soil vapor sampling to assess potential migration of soil vapor in May 2004. In order to assist with evaluation of the sampling results, a chemical usage survey was also performed in May 2004. Evaluation of the indoor air samples indicated that vapors were present in the building.

Additional tasks were proposed to evaluate indoor air quality in an *Addendum to the OSS RI/FS Work Plan* (CDM, October 20, 2004). Soil vapor sampling was conducted at the former Skateland facility along the surrounding utility corridors and around the building in November 2004 and the results and preliminary findings were submitted to USEPA in the *Preliminary Evaluation of Soil Gas Results from November 2004* (CDM, February 3, 2005). Air purifiers were installed in the boys and girls restrooms and kitchen during December 2004. CDM conducted SSD testing in September 2005, and submitted a *Skateland SubSlab Depressurization Testing Technical Memorandum* (CDM, December 6, 2005) of the findings. CDM conducted a second SSD test to determine whether the concrete masonry unit dividing the rink and party/arcade area was acting as a vapor barrier.

On April 6, 2006, USEPA issued a *Request for a Removal Action* to mitigate vapor migration into the Skateland building (EPA, April 6, 2006). OPOG entered into an amendment to the Consent Decree and Supplemental Statement of Work to either mitigate the vapor migration or conduct an Alternate Response Action. To procure property to house the proposed remediation systems, OPOG purchased the Skateland property on October 1, 2006. The subsequent closure of Skateland met the requirements of the Alternate Response Action. The former Skateland building was demolished in March and April 2007. The RI report (CDM, November 14, 2007) summarizes the testing procedures and results for samples collected from the former Skateland facility.

1.3 Site Characteristics

1.3.1 Climate and Topography

The climate of the area is characterized as semi-arid, with an average annual precipitation of approximately 16 inches. Precipitation occurs mainly during the winter and spring months. The site is relatively flat and is situated at an approximate elevation of 220 feet above mean sea level (MSL). An aerial photographic review indicated that exterior areas were primarily unpaved until approximately 1972.

1.3.2 Regional Geology and Hydrogeology

The site is located in the Montebello Forebay area of the Central Groundwater Basin of the Coastal Plain of Los Angeles. The Montebello Forebay is an important area of groundwater recharge. Groundwater flow in the area is generally towards the southwest, originating in an area of recharge and flowing toward an area of discharge (i.e., production pumping in the Central basin).

The site is underlain by low permeability silty and clayey soils of the upper Pleistocene Lakewood Formation. The Lakewood Formation is locally derived from erosion of the Puente Hills to the northeast, and may be overlain by a thin cover of Holocene slopewash and alluvium that can be difficult to distinguish from the Lakewood Formation on the basis of lithology. Furthermore, local merging and interfingering of geologic units near the basin margin makes positive identification of individual geologic units encountered in borings problematic. The uppermost aquifer in the site vicinity, probably the Gage aquifer in the lower portion of the Lakewood Formation, does not occur directly beneath the site.

The nearest active downgradient water supply wells are located more than one mile from the site. The closest active well (City of Santa Fe Springs well 30R3) is located on Dice Road by Burke Street, approximately 1.25 miles downgradient of the site. According to the driller's log, this well is screened from 200 to 900 feet below ground surface (bgs) and at least two aquitards appear to be present between the shallowest aquifer and the top of the well screen.

1.3.3 Local Geology and Hydrogeology

This description of local geology and hydrogeology is based on an evaluation of lithologic logs from borings and wells advanced onsite and downgradient of the site. To date, OPOG has installed a total of 11 groundwater monitoring wells (OW1b, OW2, OW3, OW3b, OW4a, OW4b, OW5, OW6, OW6, OW8, and OW8b) to investigate and characterize lithology and water quality in the Phase 1a and downgradient areas (Figure 1-2). A 12th well, located on the former Omega property (OW1) was installed by the former owner in 1996. Five groundwater extraction wells (EW1 through EW5) were also installed along Putnam Street, a short distance downgradient of the former Omega property, during July 2006.

Lithologic data obtained from piezometers and wells installed along Putnam Street indicate that the uppermost aquifer in this area is comprised of sand, silty sand and well graded gravel containing significant silt. The aquifer is interbedded, and in the area between piezometers PZ1 and PZ2 contains a finer-grained interval separating the upper and lower portion of the aquifer. Information gained during installation of the deep well on Putnam Street (OW8b) indicates that a 26-foot thick clay separates the upper aquifer from the next deeper sandy interval that was screened in this well. This unit may correlate with the low permeability unit separating the Gage and Jefferson aquifers; however, the nearest regional cross-section in Bulletin 104 (State of California Department of Water Resources, 1961) suggests that this intervening unit is somewhat thicker.

Regional hydrogeologic information is inconclusive on the presence or absence of major regionally named aquifers in this portion of the Whittier Area. A cross-section about 1.5 miles south of the site is presented in Bulletin 104 (DWR 1961) that suggests that the uppermost aquifers present are the Gage and Jefferson Aquifers. The upper aquifer at the site may represent the Gage aquifer, while the lower aquifer is potentially the Jefferson aquifer.

Vadose Zone

The vadose zone is generally comprised of clayey silts with occasional sand lenses. The shallower interbedded silty clays and clays are characterized by alternating layers of high and low permeability soil. Soil boring logs show fine grained materials (silts, silty clays, clays, corresponding to higher electrical conductivity) with occasional thin lenses of fine sand (lower electrical conductivity).

An important lithologic layer starting at an approximate depth of 30 feet bgs (hereinafter referred to as the "30-foot unit") was found dipping to the west and southwest. The 30-foot unit has a characteristic double peak signature on the membrane interface probe (MIP) electrical conductivity logs (the inverse of electrical resistivity), with a lower conductivity interbed in the middle of the unit likely consisting of siltier materials. Nearly all borings show a 1- to 4-foot thick unit with lower electrical conductance, interpreted to be a sandy to silty lithology with less clay overlying the marker bed. The 30-foot unit itself is between 3.5 to 11 feet thick, and it does not appear to be an effective barrier to vertical soil vapor migration. The top of the zone slopes generally to the west-southwest with a southwesterly trough directly beneath the center of the Site. The 30-foot unit appears to be an important factor in contaminant fate and transport at the Site, which will be further discussed in Section 2.

1.3.4 Water Level and Groundwater Elevation Results

Water level measurements were collected and groundwater elevation contour maps were prepared for measurements collected monthly during May 2001 through April 2002, and semi-annually during April 2002 through August 2005. The most recent water level measurements were taken in August 2007. The direction of groundwater flow in the upper aquifer has been consistently towards the southwest during all water level monitoring events as demonstrated on the groundwater elevation contour maps provided in Section 3 of the *Revised Report Addendum for Additional Data Collection in the Phase 1a Area* (CDM, March 30, 2005).

There is a noticeable change in hydraulic gradient in the vicinity of Washington Boulevard and the OW4 monitoring well pair, which corresponds to the observed transition from finer-grained subsurface lithology in the area northeast of Washington Boulevard to coarser-grained subsurface lithology in the area southwest of Washington Boulevard. The hydraulic gradient upgradient of well pair OW4 is significantly steeper than the hydraulic gradient downgradient of well pair OW4. Similar trends were observed during all prior sampling events.

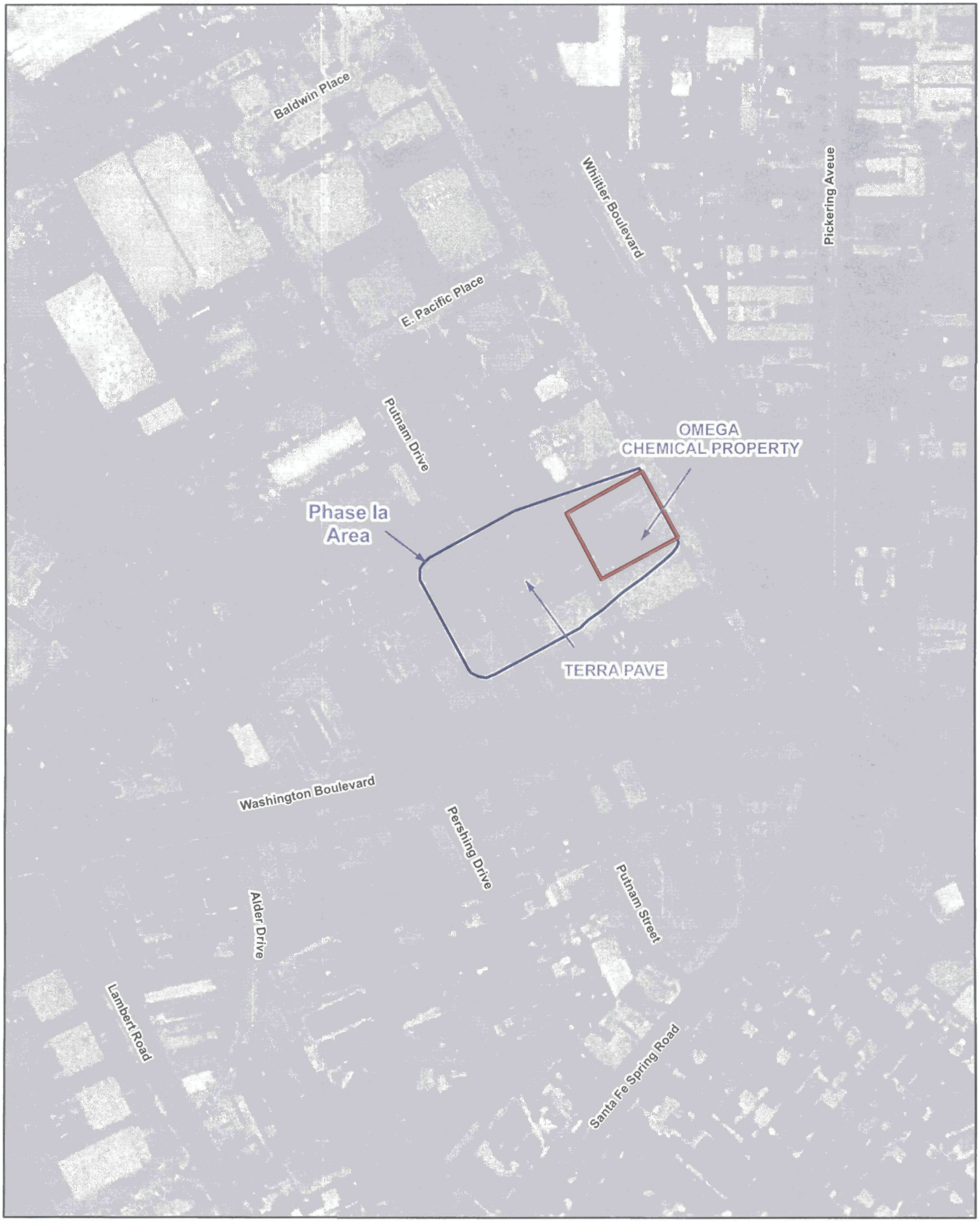
Water levels generally declined during the period from March 2001 to August 2004 (e.g., from 74.19 feet bgs in well OW1 during May 2001 to 78.84 feet bgs during August 2004). Following the August 2004 sampling event, water levels in well OW1 gradually increased to a high of 74.94 feet bgs in October 2006, and then decreased to 76.17 feet bgs in August 2007. Water levels followed this same general trend at the other monitoring well locations.

As observed at all four locations with shallow and deeper well pairs (OW1, OW3, OW4, and OW8) water levels also followed these same general trends in the deeper wells. In addition, water levels in the deeper wells have been consistently deeper than the water levels in the shallow wells at the well pair locations. During the most recent August 2007 sampling event, these differences ranged from 6.79 feet at location OW1/OW1b to 13.16 feet at location OW3/OW3b.

This head difference suggests that significant hydraulic separation exists between the shallow and deeper screened zones. Although a downward gradient exists from the shallow zone to the deep formation, the water quality results from the three well pairs show that the hydraulic separation between the two zones limits downward vertical migration.

1.3.5 Aquifer Characteristics

Numerous aquifer tests have been performed on selected Omega wells over the past eight years, as follows: slug tests and step-drawdown testing on wells OW-1b, OW-2, and OW-3 in 1999; short-term (approximately 4 hours) constant discharge testing on wells OW-2, OW-3, OW4a, and OW8 in 2003; and more recently approximately 24-hours of constant discharge testing performed in September 2006 on five wells installed in mid-2006 (EW-1 through EW-5) that are proposed for groundwater extraction as part of the Phase 1a area groundwater remedy. A Technical Memorandum (TM) detailing testing procedures and an evaluation of the testing results was prepared and submitted to USEPA in late-2006 (CDM, November 7, 2006). Evaluation of the September 2006 extraction well testing of extraction wells EW1 through EW5 indicated that transmissivities along Putnam Street ranged from 1,050 to 5890 square feet (ft^2)/day, with hydraulic conductivity ranging from 58 to 327 ft/day. The five extraction wells sustained a total of 25.5 gallons per minute (gpm) during testing, and a maximum drawdown of two feet was observed in the shallow aquifer. No significant drawdown was induced in the deeper screened zone at locations OW3b and OW8b during the testing, indicating minimal hydraulic communication between the shallow and deeper screened zones.



CDM

Legend

Omega Chemical Property

Phase Ia Area

N W E S

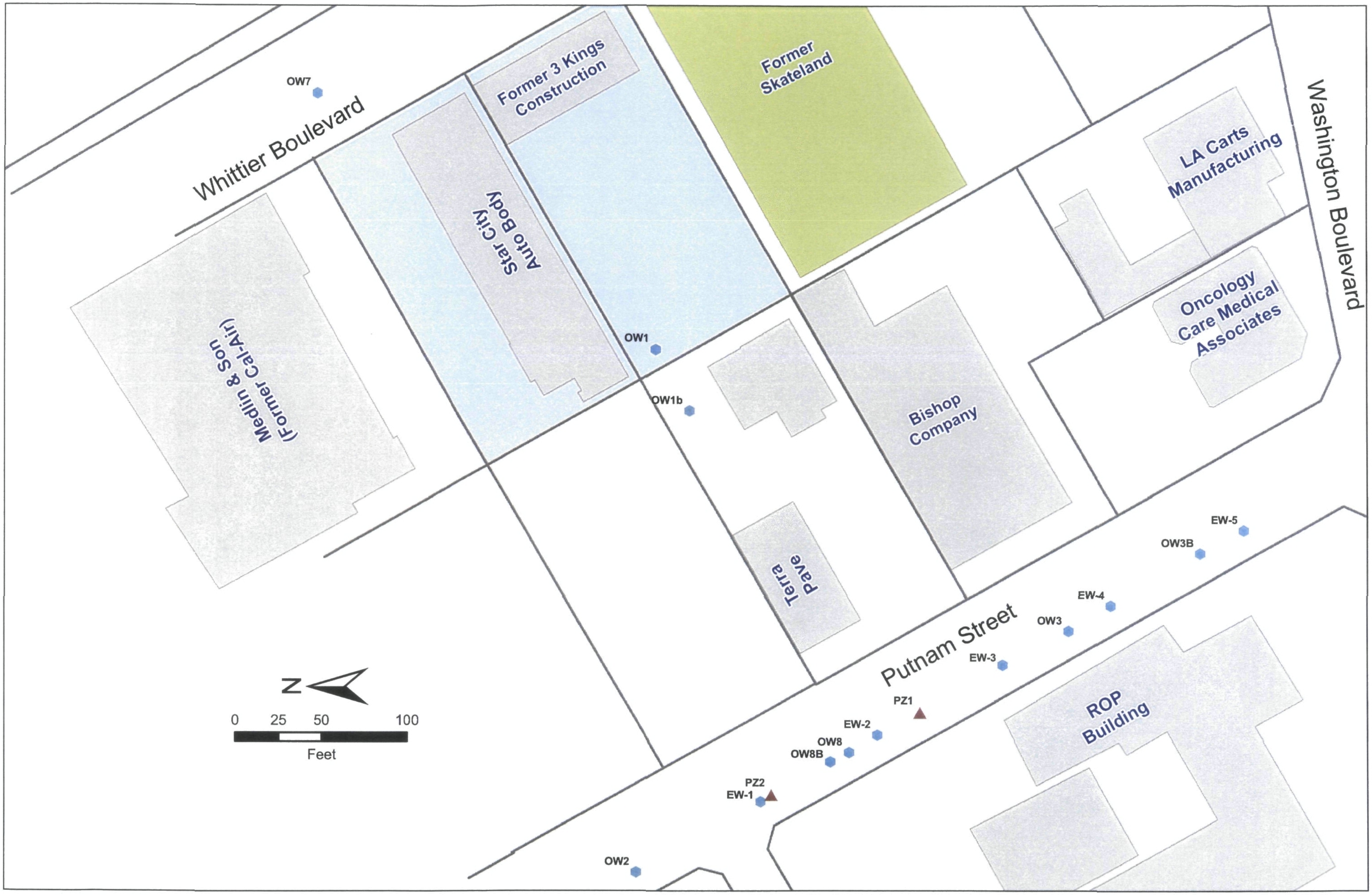
0 100 200 400

Feet

Omega Chemical

Site Location Map

Figure 1-1



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Groundwater Sample Location
- Piezometer Location

CDM

Omega Chemical

Well / Piezometer Locations and Vicinity Map

Figure 1-2

Section 2
Contaminant Sources, Nature and Extent, and Fate and Transport

This section briefly summarizes the findings, as presented in Section 5 of the final RI Report (CDM, November 15, 2007), regarding sources of contamination, the nature and extent of contamination, and contaminant fate and transport. Sections 4 and 5 and Appendix B of the final RI Report also contain figures and tables which illustrate and summarize the results of the RI.

2.1 Sources of Contamination

The contaminants, which primarily consist of volatile organic compounds (VOCs), present in the subsurface at the former Omega Chemical property, may have been released via a combination of the following mechanisms:

- Leaking above and/or underground storage tanks and associated piping; historical information suggests that such potential sources are most likely on the northern and northwestern portion of the former Omega Chemical property (see Figure 2-1) which illustrates the locations of historical tanks and the loading dock area)

- Transport of on-site surface spillage (e.g., from above ground tanks, drum storage areas, poor housekeeping practices, etc.) over pavement to unpaved areas with subsequent infiltration; these types of releases may have occurred anywhere on the former Omega Chemical property and may also have been transported via surface runoff onto directly adjacent properties (i.e., Terra Pave).

- Leaking drums, particularly those which were located in the northern and northwestern portion of the former Omega Chemical property

Additionally, the potential also existed for the former presence of a direct conduit (i.e., monitoring well BMW1, installed in 1988 which has never been found), to have transmitted contaminants from the ground surface straight to groundwater. In addition, a 500-gallon UST removed from the loading dock area in 1987 is also considered a source area.

Once in the ground, the contaminants likely infiltrated into the vadose zone, dispersing laterally at permeability contrasts until the 30-foot unit was encountered. Based on lithologic information collected for the RI, the 30-foot unit appears to include a greater percentage of fine grained materials when compared to overlying and underlying sediments. As a result, it likely retarded the vertical migration of contaminants, which in turn led to accumulation and further spreading of contamination laterally across the top of this unit. As shown in Figure 2-2, the top of this permeability contrast slopes toward the southwest, which likely led to preferential lateral transport in this direction. Released liquids also penetrated the 30-foot unit and continued to infiltrate to the water table.

This site conceptual model is primarily supported by the MIP results that were collected across the site. Three MIP borings show evidence of high relative concentrations of volatiles from near surface to the 30-foot unit.

The total VOC map (Figure 2-3), which presents the sum of all detected VOCs in soil vapor from ground surface to a depth of 30 feet, is also indicative of the locations where releases occurred. This map shows the highest soil vapor concentrations are located between the Star City Auto and Medlin buildings, west of the Star City Auto building and in the parking lot south of the Star City Auto building. These locations of elevated shallow soil vapor VOC concentrations are consistent with information from the MIP exploration borings with respect to probable sources of release.

2.2 Nature and Extent of Contamination

This section summarizes the understanding of the nature and extent of contamination at the site, and compares detected concentrations to the EPA Region 9 PRGs for soil and media. Additionally, soil vapor data will be compared to CHHSLs. Site-specific PRGs were developed in the HHRA to assist in decisions regarding remedial actions for soil and soil vapor. In the interim, the PRGs (both industrial and residential) were used as a means to define the lateral extent of contamination.

The HHRA developed a list of COCs based on the analytical results for soil and soil vapor samples. The COCs include: 1,4-dioxane, 1,1,1-trichloroethane, 1,1,2-trichlorethane, 1,2-dichlorobenzene, 2-methylnaphthalene, 4,4-DDD, 4,4-DDE, 4,4-DDT, aluminum, antimony, barium, benzo(a) anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzyl alcohol, beryllium, bis(2-ethylhexyl)phthalate, butylbenzyl phthalate, cadmium, chromium, chrysene, cobalt, copper, dieldrin, fluoranthene, iron, isophorone, lead, manganese, mercury, molybdenum, naphthalene, nickel, PCB-1254, total PCBs, phenanthrene, pyrene, silver, PCE, thallium, vanadium, 1,1-dichoroethane, 1,1-dichloroethene, 1,2-dichloroethane, benzene, carbon tetrachloride, chloroform, trichloroethene, trichlorofluoromethane, 1,2-dichloroethane and zinc.

Site-specific PRGs have been developed for the following COCs: 1,4-dioxane, benzo(a) anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, dieldrin, iron, lead, PCB – 1254, total PCBs, PCE, vanadium, 1,1-dichoroethane, 1,1-dichloroethene, 1,2-dichloroethane, benzene, carbon tetrachloride, chloroform, trichloroethene, and trichlorofluoromethane.

2.2.1 Soil

Tetrachloroethene (PCE) was detected above its residential and industrial/ commercial PRGs in soils at the site. PCE is the compound that is the most widespread, thus, it is used to define the area that has been impacted by releases at and emanating from the former Omega Chemical property. Figures 2-4 and 2-5 present the locations where soil samples had exceedances of the PRGs for PCE at depths less than 30 feet and greater than 30 feet, respectively.

2.2.2 Soil Vapor and Indoor Air

As shown on RI Report Table 4-5, a total of 44 VOCs were detected at least once in the soil vapor samples. PCE is the most widespread compound at the site, thus, it is used to define the extent of contamination at the site. Other compounds are present at high concentrations and are widely distributed, but not to the extent of PCE.

Shallow Vadose Zone The total VOC dot plot for shallow soil vapor samples (Figure 2-6) indicates that the areas with highest VOC concentrations in the vadose zone above the 30-foot unit are primarily located at the former Omega Chemical property. In general, VOC concentrations above the 30-foot unit decrease to the south and southwest of this location. Soil vapor VOCs to the east, along Whittier Blvd., were relatively very low in shallow soil vapor samples.

Deeper Vadose Zone In addition to high VOC concentrations at the Omega Property, vadose zone soil vapor VOC concentrations below the 30-foot unit were also high in the areas between the Star City and Medlin buildings, near the Terra Pave building (VP-14 and VP-15), and near the Bishop building (VP-18). Moderate total VOC concentrations were present in >30 foot soil vapor samples collected from a location southeast of Skateland (VP-24) and to the southwest of the Medlin building (VP-29, VP-21 and VP-17). As with the shallow vadose zone results, soil vapor VOCs to the east along Whittier Blvd. were relatively very low in >30 foot samples.

VOC contamination near the base of the vadose zone is in dynamic equilibrium among the various phases (i.e., aqueous, soil, and soil vapor). VOCs in the capillary fringe and in groundwater are the probable sources of deep soil vapor contamination. The 30-foot unit is not a barrier to vertical soil vapor migration.

2.2.3 Groundwater

Groundwater beneath the site is contaminated with, in general, the same compounds detected in soils and soil vapor at the former Omega Chemical property. Specifically, PCE is, by far, the most prevalent contaminant in groundwater and occurs in the highest concentrations at levels exceeding 1,000 mg/l. Additionally, similar to soil vapors at the former Omega Chemical property, Freons (both 11 and 113) and trichloroethene (TCE) have also been detected in groundwater in concentrations exceeding 1 mg/l. Other detected compounds in groundwater include 1,1,1-trichloroethane (TCA), 1,1- dichloroethene (DCE), and cis-1,2-DCE.

Data collected for the RI suggest that the groundwater contamination may have been derived by the vertical migration of VOCs from source areas at the ground surface through the vadose zone to groundwater. The 30-foot unit appears to provide some impediment to this vertical transport, but is not considered a complete barrier. This migration pathway has resulted in the partitioning of vertically migrating contaminant mass onto the soil matrix, which in turn can provide a continuing source to soil vapor.

2.3 Contaminant Fate and Transport

The fate and transport of the site COCs in soils is affected by a variety of chemical, physical, and biological processes. Typically, the most important processes contributing to the ultimate fate of soil contaminants are volatilization and biodegradation. The characteristics of individual compounds also affect the fate and transport processes active at the site. For example, Freons appear to have migrated greater distances likely due to their lesser degree of degradation, higher volatility, and lesser capacity for sorption.

Migration Pathways

Migration of contaminants at the site is postulated to have been primarily vertically through the unsaturated zone soil profile. As vertical migration took place, lateral spreading occurred when contrasting permeability zones were encountered, such as within the sandy materials overlying the 30-foot unit. Vertical leakage through this 30-foot unit may have occurred as contamination moved laterally along the 30-foot unit, and then downward through the unit into the saturated zone. Contaminants may also be transported with groundwater and volatilize back into the vadose zone, where they diffuse laterally and vertically through the unsaturated materials. In addition, surface runoff is another possible pathway which may have contributed to the lateral spreading of contamination.

Potential Indoor Air Transport Mechanisms

The contaminant vapor migration pathway is a potential concern. Contaminant vapors migrate laterally from subsurface soils beneath the former Omega Chemical property to adjacent properties. VOC vapors also occur through volatilization (off-gassing) of contaminants dissolved in groundwater. Subsurface vapors can migrate upward and enter buildings.

Processes Affecting Subsurface Contaminant Fate and Transport

Various naturally-occurring processes affect the transport of contaminants in soils. Most of these mechanisms or processes combine to decrease contaminant concentrations. However, other processes, such as desorption of adsorbed contaminants and matrix diffusion may prolong the time necessary for soils remediation. The following mechanisms also affect the fate and transport of contaminants in the site soils:

- Biological transformation (biodegradation)
- Adsorption to and desorption from the soils
- Matrix diffusion

- Diffusion in pore water and soil vapor
- Advection in pore water and soil vapor
- Abiotic degradation (chemical transformation)
- Volatilization
- Dispersion

Volatilization plays a significant role in contamination fate and transport at this site, as the majority of contaminants are VOCs. The main mechanism for the transformation of VOCs in the subsurface is probably biochemical biodegradation, as discussed in more detail below.

Biological Transformation

The principal contaminants in soils are chloroethanes (e.g., 1,1,1-TCA) and chloroethenes (e.g., PCE and TCE) and their respective family of metabolic products and Freons. Petroleum hydrocarbons are also found in site soils. In general terms, the biodegradation of petroleum hydrocarbons and other organic compounds (e.g., naturally-occurring organic materials such as humic substances) serve as the carbon and energy sources (i.e., electron donors) for microorganisms. For PCE and TCE, reductive dechlorination could eventually result in the formation of ethene and ethane. However, incomplete reductive dechlorination could lead to the accumulation of intermediate toxic products (e.g., vinyl chloride), although the lower chlorinated contaminants may subsequently degrade to innocuous carbon dioxide through oxidation processes.

The presence of cis-1,2-DCE and vinyl chloride in some soil vapor samples suggests that there are at least limited locations where subsurface conditions favor anaerobic degradation of PCE and/or TCE.

TCA, an additional source contaminant present at the site, is subject to abiotic transformations under aerobic and anaerobic conditions, and biological transformations under anaerobic conditions. The abiotic and biotic pathways are important to the ultimate fate of chloroethanes. In particular, 1,1,1-TCA may be transformed abiotically to form 1,1-DCE that can then undergo reductive dechlorination to form VC, and ultimately over time ethene and ethane. The frequent presence of 1,1-DCE in the subsurface is likely due, at least in part, to the abiotic degradation of 1,1,1-TCA.

Under anaerobic conditions, 1,1,1-TCA may also be rapidly transformed by biotic processes into 1,1-DCA, which may be further reduced to CA. CA is relatively stable biologically under anaerobic conditions, but is transformed rapidly to ethanol and chloride by an abiotic hydrolysis reaction.

In general, biodegradation of Freons is expected to be a minor contributor to the fate of this class of compounds in the subsurface.

2.4 Human Health Risk Assessment Findings

The following assessments were performed as part of the HHRA:

- Examined the history of the Omega Chemical site in Whittier, CA, and identified types of chemicals used and likely release mechanisms for these chemicals to enter the environment
- Evaluated data collected to characterize the site and existing contamination and used the most recent of these data to select chemicals of potential concern (COPCs) and to calculate exposure point concentrations
- Analyzed the potential for exposure to COPCs at the site though an evaluation of people that might be exposed, exposure pathways that might result in significant contact between these people and COPCs, and identification of exposure parameters appropriate for quantifying exposure resulting from this contact.
- Identified appropriate toxicity criteria for site COPCs
- Estimated risk to current and potential future receptors (people) that might contact contamination
- Evaluated uncertainties in data, exposure, toxicity and risk characterization aspects of the HHRA
- Calculated health-based remediation goals (site-specific PRGs) for use in remediation decisions for the site

Results of the above assessments were summarized in the HHRA, as follows:

- Field investigations since 2004 provide a recent and complete site characterization. High confidence can be assigned to use of these data to select chemicals of potential concern and to estimate exposure point concentrations.
- Commercial/industrial land use is an appropriate assumption for future site use. The site has been used for such purpose since it was developed from agricultural land in the 1950's. In addition, City representatives have stated that it is unlikely that the former Omega Chemical property will be redeveloped for residential uses (Adams, 2007), although the zoning of the site in the Whittier Blvd. Specific Plan-Workplace District allows for Live/Work units and multi-family housing.
- Among receptors likely to be exposed to site-related contaminants, the highest cancer risks and noncancer hazards are associated with exposure of hypothetical future residents, with risks above the EPA risk range and hazards above the target threshold.

- The pathway that suggests the highest potential for exposure involves intrusion of vapors into indoor air spaces. Inhalation of these vapors indoors results in the highest estimates of potential cancer risk and noncancer hazard.

- PCE is the primary COPC of concern at the site. For example, inhalation of indoor air suggests potential total inhalation cancer risks for current industrial workers ranging from 8E-6 to 7E-5. Cancer risk associated with inhalation exposure to PCE alone ranges from 5E-7 to 4E-05. Estimated hazards for PCE were relatively low, however. HQs for exposure to indoor air for PCE ranged from 0.01 to 1.6 compared to a total inhalation HIs ranging from 0.06 to 8.

- Total cancer risk estimates for future commercial/industrial indoor worker based on data from All Parcels (CTE, 9E-6 to 3E-4 and RME, 1E-5 to 5E-4) are above the EPA risk range. Total cancer risk estimates for future commercial/industrial outdoor worker based on data from All Parcels (CTE, 1E-5 to 2E-5 and RME, 1E-5 to 2E-5) are above the point of departure of one in one million but within the EPA risk range. Cancer risks for the future industrial/commercial indoor worker are primarily attributable to inhalation of indoor air. PCE in soil gas accounts for 90 percent of the total inhalation risk. Cancer risks for future industrial/commercial outdoor worker are primarily attributable to exposure to COPCs in soil.

- Potential risks associated with exposure to ambient (urban background) concentrations of VOCs are as high as $3x10^{-5}$ and may account for 12 to essentially 100 percent of total risks estimated for indoor exposures, depending on parcel. LA Carts/Oncology Care may not be affected by site-related VOCs. Further, subsurface VOC contamination appears to be insufficient to sustain releases that would produce significant ambient air concentrations over extended periods of time.

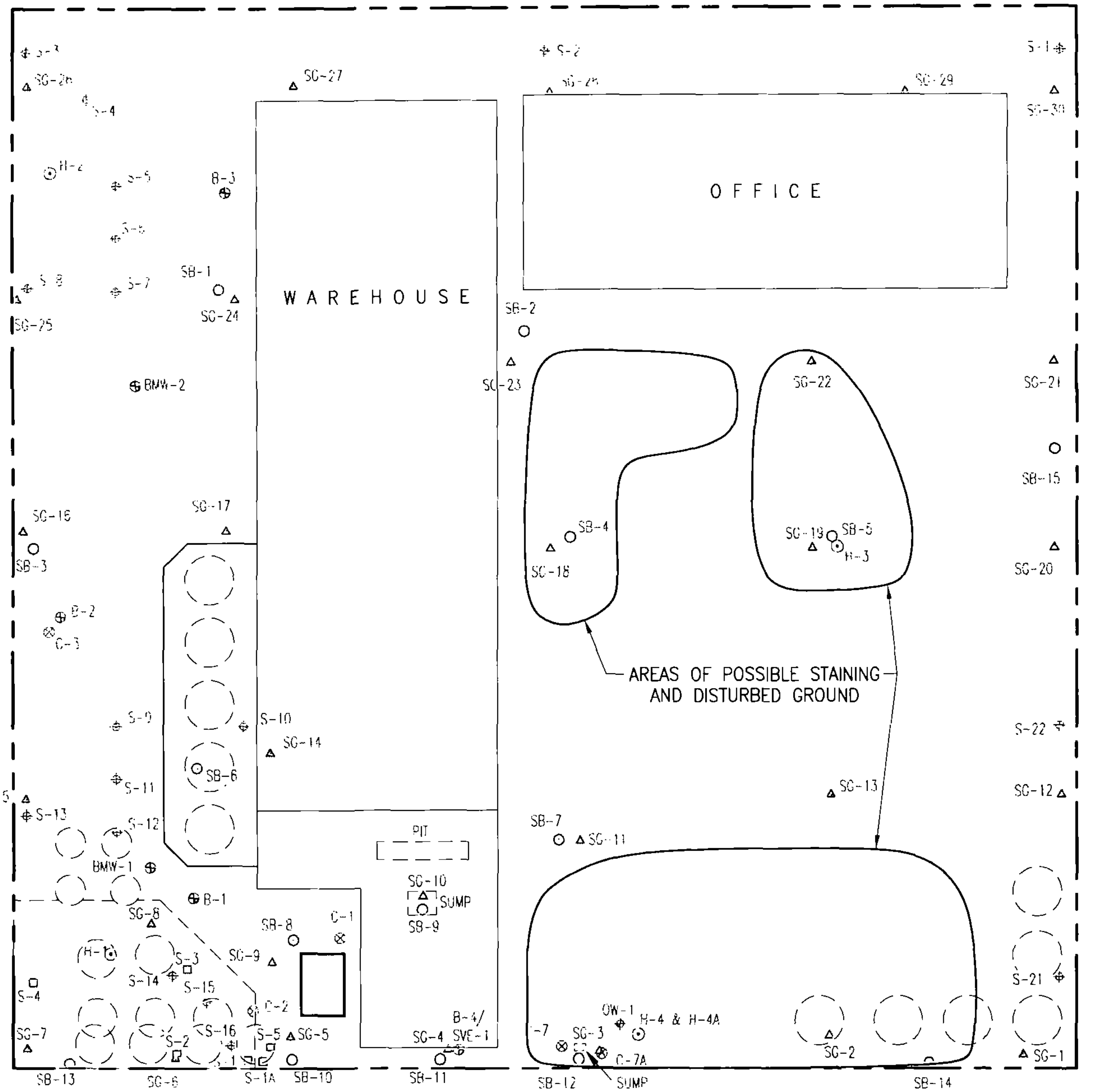
- Ambient air risks for construction workers are within and near the lower end of the EPA risk range, and ambient air hazards are below the target threshold. Subsurface VOC contamination appears to be insufficient to sustain releases that would produce significant ambient air concentrations over the one-year time period assumed for construction worker exposures.

- Hypothetical exposure to contaminants in soil is unlikely to occur, since soil is currently covered with buildings, asphalt, and concrete and such cover is likely to remain even if the site is redeveloped for other commercial/industrial purposes in the future. Even if the current property cover is replaced by green-belt type landscape, it is unlikely that contaminated soils would be exposed at the ground surface where direct contact (e.g., dermal contact or ingestion) could occur. Further, volatile COPCs, in particular PCE, acetone, and toluene, will not persist in non-volatile form in soils exposed during excavation, and direct contact exposures (incidental ingestion and dermal contact) for construction worker exposures via these pathways are expected to be minimal. These VOCs along with benzo(a)pyrene were associated with the bulk of risks and hazards estimated for direct contact exposure to surface soils.

- Uncertainties in the HHRA suggest that site-related risks have been adequately characterized to support risk management decisions. In fact, the database is biased toward source/release areas and likely overstates levels of contamination for the site as a whole.

- Site-related risks involving exposure to PCE vapors in indoor air appear to be adequately assessed using available site-specific data.

- Site-specific PRGs developed for PCE can be used upon approval by EPA with confidence in evaluating remedial alternatives, if the site is deemed by EPA to pose an unacceptable risk.



LEGEND
- Leroy Crandall Soil Boring (1985)
- ENSR Soil Boring (1988)
- ENSR Groundwater Monitoring Well (1988)
- England/Hargis Soil Boring (January 1996)
- England/Hargis Soil Gas Sample (December 1995)
- England/Hargis Monitoring Well (June 1996)
- *England/Hargis Hydropunch (March 1996)*
- England/Hargis Soil Boring (March 1996)
- ERT Soil Gas Sample (1988)
- Feature Removed

Fomer 500 Gallon UST Location

Note: All locations approximate.

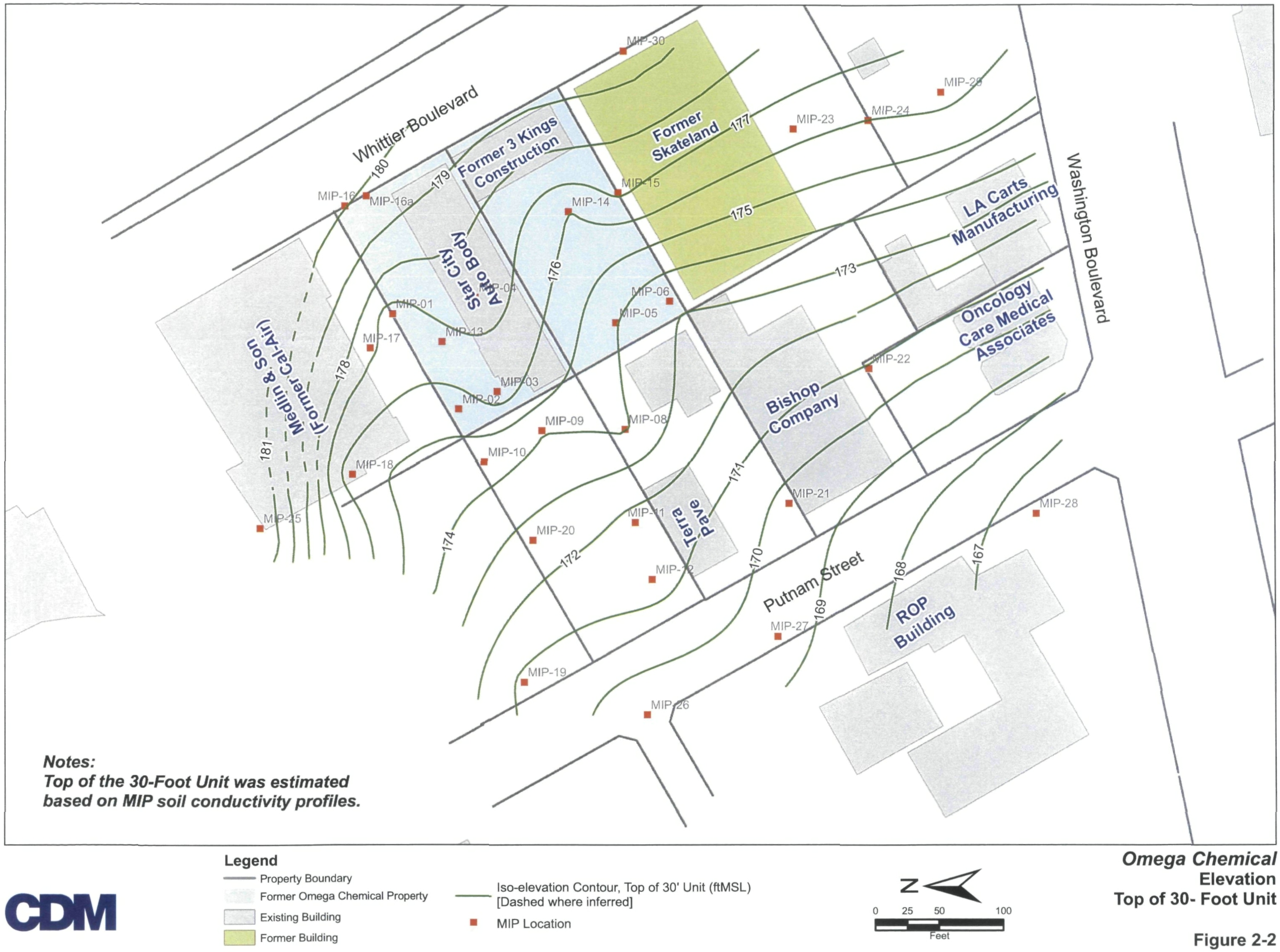
DATE: Dec 06, 2006 11:55am XREFS: PropSamp USER: nguyens
DWG: C:\Documents and Settings\nguyens\Desktop\Omega\00-sheets\PSAO-HistPhot.dwg

OMEGA CHEMICAL

Potential Source Areas And Historic Sample Locations

CDM

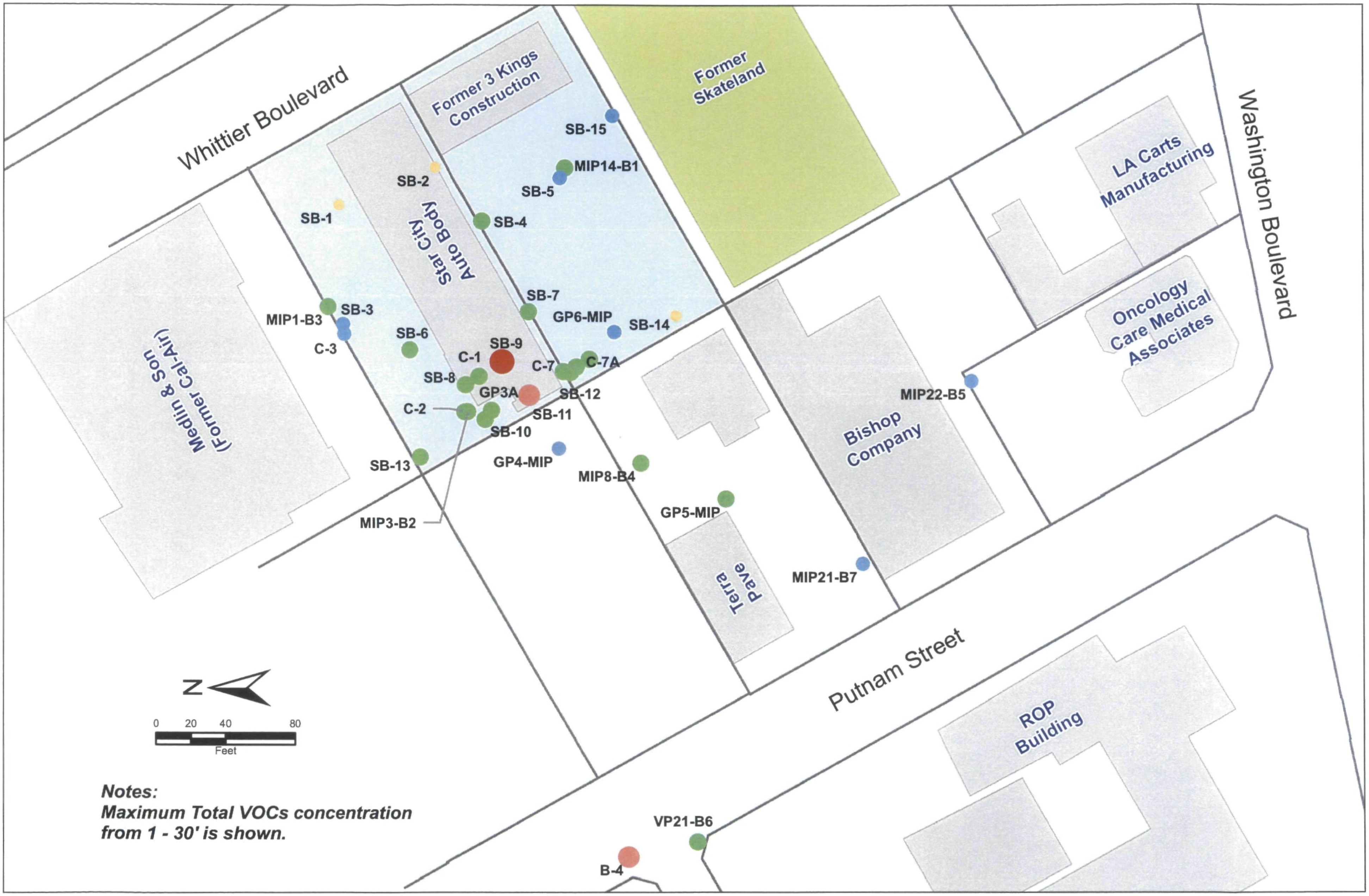
Figure 2-1



CDM

Omega Chemical
Elevation
Top of 30- Foot Unit

Figure 2-2



Notes:
Maximum Total VOCs concentration from 1 - 30' is shown.

Legend

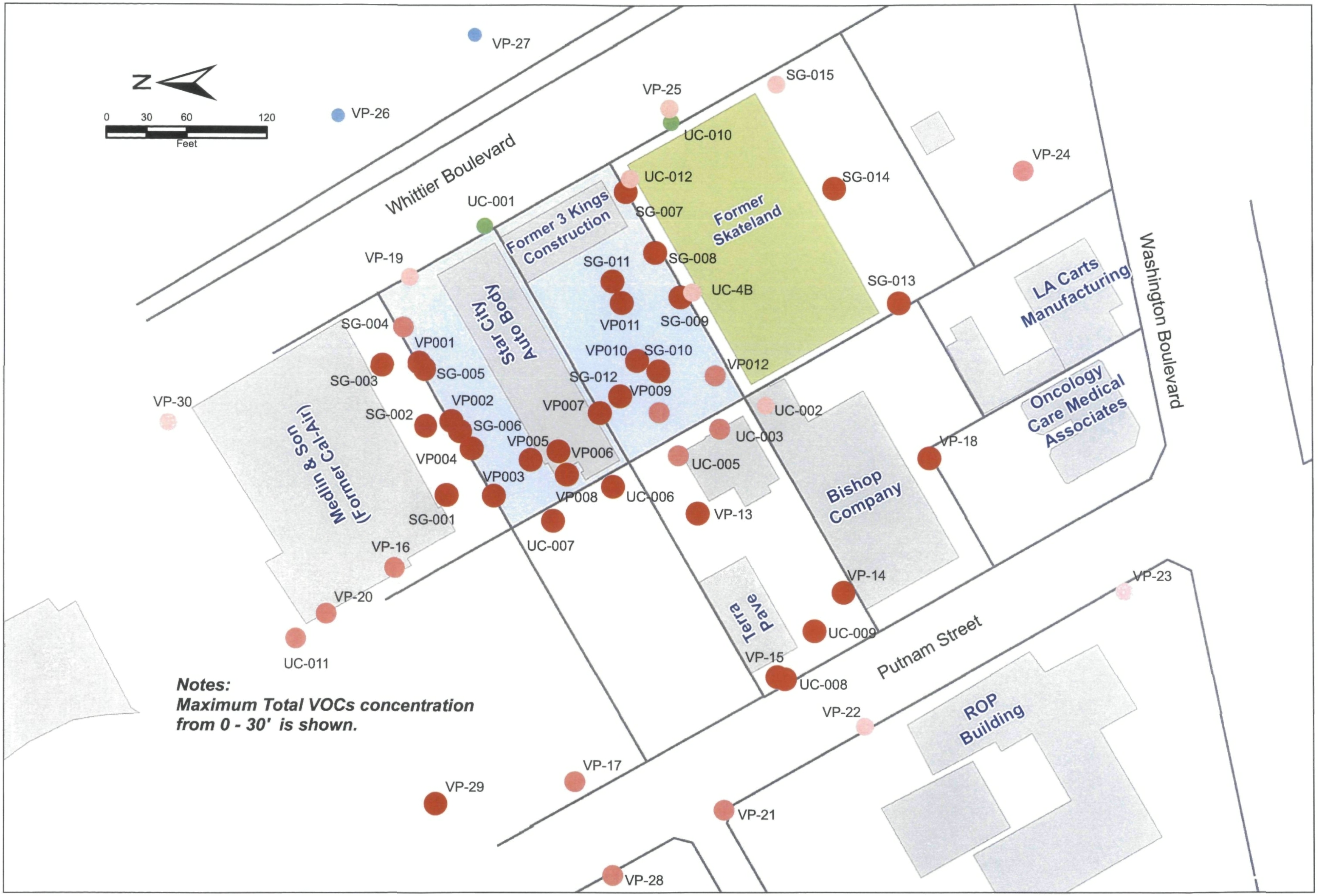
- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

Total VOCs (mg/kg)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- > 1,000

CDM

Omega Chemical
Soil Concentration Distribution (1 - 30 feet)
Total VOCs
Figure 2-3



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

Total VOCs (mg/m³)

- ND - 0.1
- 0.1 - 1
- 1 - 10
- 10 - 100
- 100 - 1,000
- 1,000 - 10,000
- > 10,000

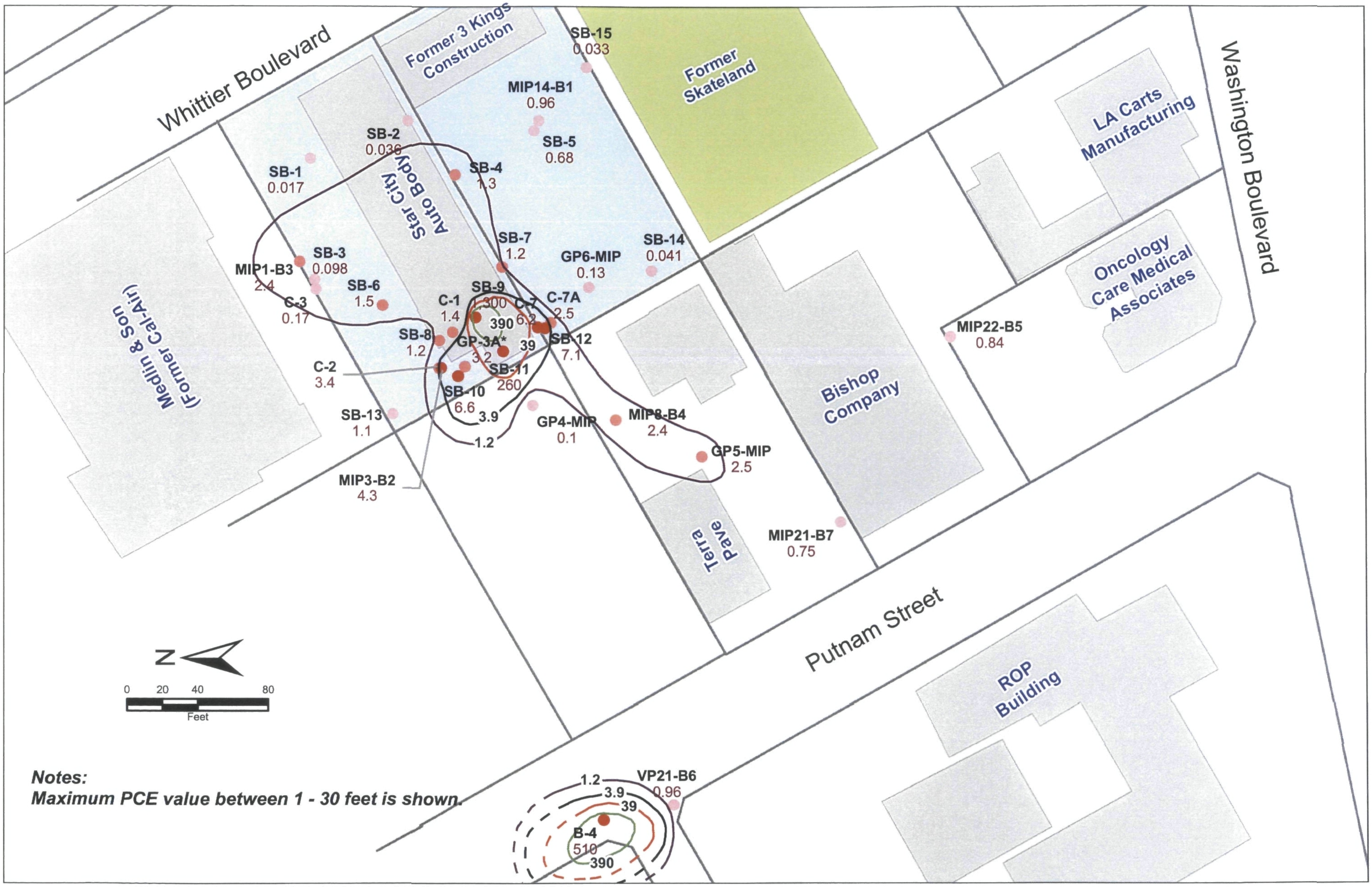
CDM

Omega Chemical

Soil Vapor Concentrations (0 - 30 feet)

Total VOCs

Figure 2-4



Notes:
Maximum PCE value between 1 - 30 feet is shown.

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Not Detected
- < 1.2 mg/kg
- 1.2 - 3.9 mg/kg
- > 3.9 mg/kg

PCE (mg/kg)

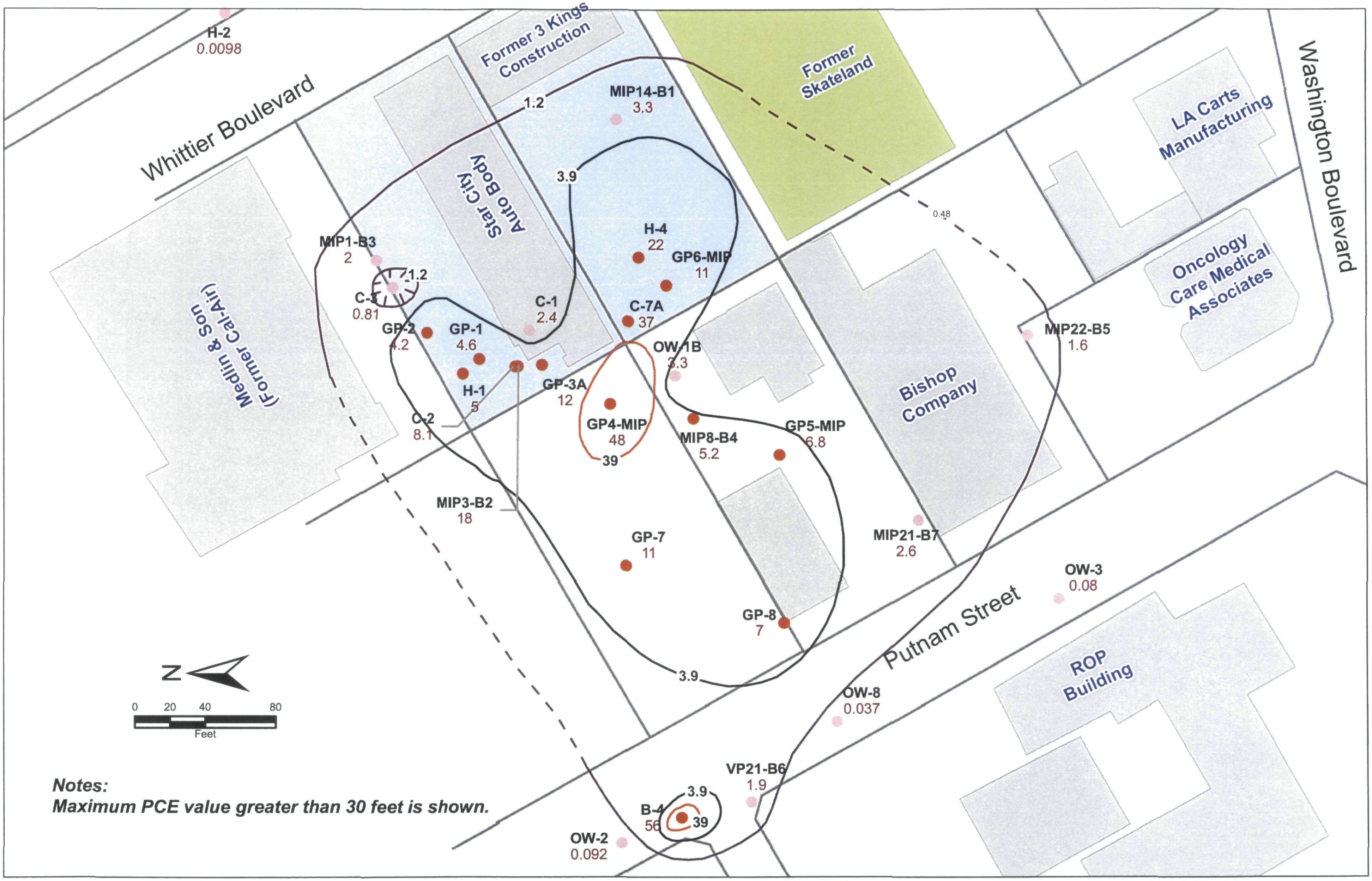
- Residential PRG (1.2 mg/kg)
- Industrial / Commercial PRG (3.9 mg/kg)
- Industrial / Commercial PRG x 10 (39 mg/kg)
- Industrial / Commercial PRG x 100 (390 mg/kg)

(Dashed where inferred.)
*This location not used to determine contours.

CDM

Omega Chemical
Locations with Soil PCE
PRG Exceedance from 1 to 30 Feet

Figure 2-5



Notes:
Maximum PCE value greater than 30 feet is shown.

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building

- Not Detected
- < 1.2 mg/kg
- 1.2 - 3.9 mg/kg
- > 3.9 mg/kg

PCE (mg/kg)

- Residential PRG (1.2 mg/kg)
- Industrial / Commercial PRG (3.9 mg/kg)
- Industrial / Commercial PRG x 10 (39 mg/kg)

(Dashed where inferred.)

CDM

Omega Chemical
Locations with Soil PCE PRG Exceedance from Greater Than 30 Feet
Figure 2-6

Section 3
Development of Remedial Action Objectives

3.1 Potentially Applicable or Relevant and Appropriate Requirements (ARARs)

The NCP requires that the selected remedy for all remedial actions must attain or exceed the ARARs in environmental and public health laws. The NCP also requires removal actions to attain ARARs to the greatest extent practicable. The distinction between applicable and relevant and appropriate is critical to understanding the constraints imposed on remedial alternatives by environmental regulations other than CERCLA.

Identification of ARARs must be done on a site-specific basis and involves a two-part analysis: first, determining whether a given requirement is applicable and second, determining if a requirement that is not applicable is both relevant and appropriate.

3.1.1 Definition of ARARs

Section 121 (d) of CERCLA as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) requires that remedial actions attain a degree of cleanup that ensures protection of human health and the environment. Section 121 (d)(2) of CERCLA, 42 U.S. Code (USC) Section 9621 (d)(2) limits federal ARARs to those federal environmental laws that set a standard, requirement, criterion, or limitation that is legally applicable or relevant and appropriate to those hazardous substances, pollutants, or contaminants that will remain on site following remediation.

For contaminants that will be transferred off site, Section 121 (d) of CERCLA requires that the transfer be to a facility that is operating in compliance with applicable federal and state laws. Section 121(d) of CERCLA, as amended by SARA, also requires attainment of ARARs, including state environmental or facility siting laws, when the promulgated state requirements are more stringent than federal laws and are identified by the state in a timely manner.

In addition to applicable or relevant and appropriate requirements, the NCP provides a list of federal non-promulgated criteria, advisories and guidance, and state standards to be considered (TBC). CERCLA also provides limited circumstances in which ARARs could be waived.

3.1.1.1 Applicable Requirements

The NCP final rule for CERCLA defines applicable requirements as:

> "...those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial

> action, location or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."

State requirements are more stringent than federal requirements if the state program has federal authorization and the state requirements are at least as stringent. Applicable requirements must be met to the full extent required by law or waived by EPA.

3.1.1.2 Relevant and Appropriate Requirements

If it is determined that a requirement is not applicable to a specific release, the requirement may still be relevant and appropriate to the circumstances of the release. The NCP final rule for CERCLA defines relevant or appropriate requirements as:

> "...those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate."

Distinguishing a regulation that is relevant and appropriate is determined using best professional judgment, taking into account the purpose of the requirement, medium, substance, and action regulated and use or potential use of affected resources relative to the nature of these factors at the site. In some cases, a requirement may be relevant but not appropriate, given a site-specific circumstance; such a requirement is therefore not an ARAR for the site.

3.1.1.3 Other Requirements to Be Considered (TBC)

In addition to ARARs, TBC criteria are evaluated and utilized to determine the necessary level of cleanup for protection of human health or the environment. The TBCs are non-promulgated advisories, regulations, or guidance issued by federal or state government that are not legally binding and are not generally enforceable, but may have specific bearing on all or part of the action. TBCs can be used to determine the necessary level of cleanup for protection of human health or the environment where no specific ARARs exist for a chemical or situation or where such ARARs are not sufficient to be protective.

3.1.1.4 Waivers

CERCLA specifies situations under which the ARARs requirements may be waived (Section 212(d)(4)). The situations eligible for waivers include:

- Interim remedies
- Remedies in which attainment of the ARAR would pose a greater risk to human health or the environment than would non-attainment
- Technical impracticability of attainment
- Inconsistent application or enforcement of a state requirement
- Fund balancing (financial restriction within the Superfund program)
- Attainment of equivalent performance without the ARAR

3.1.1.5 Application of ARARs

ARARs will be determined based upon an analysis of which requirements are applicable or relevant and appropriate to the distinctive set of circumstances and actions contemplated at the site. The NCP requires that attainment of ARARs is considered to the extent practicable during the implementation, and completion of all remedial and removal actions.

For the ease of identification, EPA divides ARARs into three categories: chemical-specific, location-specific, and action-specific, depending on whether the requirement is triggered by the presence or emission of a chemical, by a vulnerable or protected location, or by a particular action. These ARAR categories are briefly described below.

- Chemical-specific requirements are usually health risk or technology based numerical values that may define acceptable exposure levels. These values establish the acceptable amount of concentration of a chemical that can be discharged or left in the ambient environment.
- Location-specific requirements set restrictions on the concentrations of compounds or on activities within specific locations, such as floodplains or wetlands.
- Action-specific requirements are generally technology or activity based requirements that set controls on activities pertaining to a particular treatment or disposal method.

Table 3-1 provides a detailed listing of all potential ARARs for the Site. The following text summarizes the most significant of these ARARS. Table 3-2 lists the TBCs for the Site.

3.1.2 Potential Chemical-Specific ARARs

The chemical-specific ARARs for the Omega Site are for those contaminants or chemicals of potential concern (COPC) identified in soil, soil gas, or indoor air at the Site, which were further evaluated in the HHRA, and for which subsequently site-specific Preliminary Remediation Goals (PRGs) were developed (CDM, 2007). The US EPA's Risk Assessment Guidance for Superfund (RAGS) was utilized in the HHRA. A tabular summary of Omega Site COPCs present in soil, soil gas, and indoor air is provided in the HHRA. Based on the results of the site investigation activities and data collected from the Site which was used in the HHRA, VOCs were identified as the primary group of COPCs. California Title 22 metals which were detected in soil were considered and evaluated as COPCs for soil (including lead and hexavalent chromium) but the risks posed for the metals were found to be within acceptable levels. The results of the HHRA indicated that PCE was the VOC which posed the majority of the potential health risk. The site-specific protective risk based levels for PCE which have been developed based on the HHRA are as follows:

- Indoor Air: Residential = 0.33 micrograms per cubic meter (ug/m3); Industrial = 0.91 ug/m3
- Shallow Soil Gas: Residential = 470 ug/m3; Industrial = 3000 ug/m3
- Soil: Residential = 1.2 mg/kg; Industrial = 3.9 mg/kg
- Outdoor Air: Industrial = 0.77 ug/m3

COPCs for groundwater were not evaluated in this FS as it deals with soils and soil gas only. Therefore, ARAR considerations in the Federal Safe Drinking Water Act, the California Safe Drinking Water Act, and the Water Quality Control Plan for Los Angeles Region promulgated by the California Regional Water Quality Control Board (RWQCB) are not applicable, but are considered relevant and appropriate and will be used indirectly, insofar as they affect the risk-based vadose zone clean up levels.

3.1.2.1 Federal Safe Drinking Water Act

EPA has established maximum contaminant level (MCLs) (40 CFR Part 141) under the Safe Drinking Water Act (SDWA) to protect public health from contaminants that may be found in drinking water sources. MCLs are enforceable standards that are applicable at the tap for water that is delivered directly to 25 or more people or to 15 or more service connections. MCLs are potentially applicable only to groundwater that is treated and serves as drinking water. MCLs are potentially relevant and appropriate to any water that is discharged into the environment and to in-situ groundwater at or beyond the edge of a containment area (CERCLA Compliance With Other Laws Manual [OSWER Dir. 9234.1-01, Aug. 1988]).

Under the SDWA, EPA has also designated Maximum Contaminant Level Goals (MCLGs) (40 CFR Part 141) which are health-based goals that may be more stringent than MCLs. MCLGs are based entirely on health considerations and do not take cost or feasibility into account. MCLGs are set at levels, including an adequate margin of safety, where no known or anticipated adverse health effects would occur. MCLGs are not applicable or relevant and appropriate because the MCLGs for the contaminants of concern at the Omega site are either zero (40 CFR Section 300.430(e)), or are equal to the MCLs.

The SDWA also prohibits injection which endangers an underground source of drinking water. Federal Underground Injection Control (UIC) Regulations (40 CFR 144.12 and 144.13) would apply if re-injection of extracted and treated groundwater were part of the selected alternative.

3.1.2.2 California Safe Drinking Water Act

California has established standards for sources of public drinking water, under the California Safe Drinking Water Acts of 1976 and 1996 (Health and Safety Code (H&SC) §§ 4010.1, 4026(c), and 116365). Some state MCLs are more stringent than the corresponding federal MCLs. In these instances, the more stringent MCLs would take precedence. There are also some chemicals that lack federal MCLs. Where state MCLs exist they may also be ARARs for these chemicals. MCLs are potentially applicable only to groundwater that is treated and served as drinking water.

3.1.2.3 Water Quality Control Plan for Los Angeles Region

The Los Angeles plan (commonly referred to as the 'Basin Plan') designates the beneficial uses of groundwater in the Los Angeles coastal plain to be municipal and domestic, agricultural, industrial service, and industrial process supplies (California Water Code §13240 et seq.). The Basin Plan establishes beneficial uses of ground and surface waters, establishes water quality objectives, including narrative and numerical standards, establishes implementation plans to meet water quality objectives (WQOs) and protect beneficial uses, and incorporates statewide water quality control plans and policies. The WQOs for groundwater are based on the primary MCLs. Any activity that may affect water quality must not result in the water quality exceeding the WQOs.

3.1.3 Potential Location-Specific ARARs

The site is located in an urban area that has been developed for decades and provides no suitable habitat for any species of plant or animal life. Additionally, the subsurface soils are covered with buildings, asphalt, or concrete, and no historical or newer building structures are present. Therefore, no ecological or other adverse impacts from the implementation of a suitable soil remedy are expected. Therefore, the following statutes and regulations are not applicable and therefore are not listed on Table 3-1:

- National Historic Preservation Act (16 U.S.C. § 470, 40 CFR Part 6.310(b), 36 CFR Part 800);

- Archaeological and Historic Preservation Act (16 U.S.C. § 469, 40 CFR Part 6.301(c));
- Historic Sites, Buildings, and Antiquities Act (16 U.S.C. §§ 461-467, 40 CFR Part 6.301(a));
- Location Standards for treatment, storage, and disposal facilities (TSDF) (California Code of Regulations (CCR), Title 22, Subsection 66264.18 (a) prohibition for the placement of TSDFs within 200 feet of a fault displaced during the Holocene epoch, and Subsection 66264.18 (b) requirements for TSDFs located within a 100-year floodplain to be capable of withstanding a 100-year flood;
- Endangered Species Act (15 U.S.C. $$1531-1544, 50 CFR Part 402, 40 CFR Part 6.302(h)); and
- California Fish and Game Code (Sections 2080, 5650(a) (b) and (f), 12015, and 12016) prohibiting the discharge of harmful quantities of hazardous materials into places that may deleteriously affect fish, wildlife, or plant life.

3.1.4 Potential Action-Specific ARARs

Action-specific ARARs are usually technology- or activity-based requirements for remedial activities. Action specific ARARs described in this section are intended to address those actions resulting from implementation of remedial alternatives. A brief description of potential action-specific ARARs is presented below

3.1.4.1 Local Air Quality Management

Air emissions from any treatment train proposed for remediation at the Phase 1a area are regulated by the California Air Resources Board, which implements the federal CAA as well as the California H&SC (Section 39000, et seq.) through local air quality management districts. Local districts can add additional regulations to address local air emission concerns. The local air district for the Site is the South Coast Air Quality Management District (SCAQMD). The SCAQMD has adopted several rules that may be ARARs for air stripper or VGAC emissions.

SCAQMD Regulation XIII, comprising Rules 1301 through 1313, establishes new source review requirements. Rule 1303 requires that all new sources of air pollution in the district use best available control technology (BACT) and meet appropriate offset requirements. Emissions offsets are required for all new sources that emit in excess of one pound per day.

SCAQMD Regulation XIV, consisting of Rule 1401 requires that best available control technology for toxics (T-BACT) be employed for new stationary operating equipment, so that the cumulative carcinogenic impact from air toxics does not exceed the maximum individual cancer risk limit of 10 in 1 million (1×10^{-5}). Many of the contaminants found in the site groundwater are air toxics subject to Rule 1401.

SCAQMD Rules 401 through 405 may also be ARARs depending on the selected remedial alternative. SCAQMD Rule 401 limits visible emissions from a point source; Rule 402 prohibits discharge of material that is odorous or causes injury, nuisance, or annoyance to the public; Rule 403 limits fugitive dust; Rule 404 limits particulate matter in excess of concentration standard conditions; and Rule 405 limits solid particulate matter including lead and lead compounds.

These regulations would only be applicable if the groundwater treatment-technology is modified in the design phase to include air stripping.

3.1.4.2 Federal Clean Water Act and California Porter-Cologne Water Quality Act

California's Porter-Cologne Water Quality Act (California Water Code, Div. 7) incorporates the requirements of the federal Clean Water Act (CWA) and implements additional standards and requirements for surface and groundwater of the state. This Act gives authority to the Los Angeles RWQCB to formulate and adopt a water quality control plan for its region; the RWQCB has adopted the Los Angeles Region Water Quality Control Plan (Basin Plan). The Basin Plan identifies the beneficial uses of surface and groundwater in specific watersheds and water quality objectives necessary to protect these beneficial uses.

3.1.4.3 California Code of Regulations 27 CCR §§ 20380, 20400, 20410, and 20415

These regulations require corrective action monitoring to demonstrate completion of the selected remedy for the site. Corrective action measures may be terminated when all COC concentrations are reduced below their respective concentration limits throughout the entire zone affected by the release. Section 20410 requires monitoring for compliance with remedial action objectives for three years from the date of achieving cleanup standards.

3.1.4.4 California Hazardous Waste Management Program

The federal Resource Conservation and Recovery Act (RCRA) establishes requirements for the management and disposal of hazardous wastes. In lieu of the federal RCRA program, the State of California is authorized to enforce the Hazardous Waste Control Act (H&SC, Div. 20, Chapter 6.5), and implementing regulations CCR Title 22, Division 4.5), subject to the authority retained by EPA in accordance with the Hazardous and Solid Waste Amendments of 1984 (HSWA, 40 CFR Parts 264, 268, 270, etc.). California is responsible for permitting treatment, storage and disposal facilities within its borders and carrying out other aspects of the RCRA program. Some of the Title 22 regulations may be ARARs if the selected response action for the site results in the generation or disposal of hazardous wastes.

Hazardous Waste Generator Requirements

CCR Title 22 establishes requirements applicable to generators of hazardous waste. Implementation of certain potential removal action alternatives may generate hazardous waste as a result of groundwater monitoring and well installation (e.g., contaminated soil and groundwater and used personal protective equipment). Alternatives involving groundwater treatment may also generate hazardous waste as a result of groundwater treatment to remove VOCs (e.g., spent carbon). These requirements may be applicable to a removal action at the site.

Land Disposal Restrictions
CCR Title 22 Section 66268 defines hazardous waste that cannot be disposed of to land without treatment. Land Disposal Restrictions may be applicable to the disposal of spent carbon generated during the treatment of soil vapors and groundwater for removal of VOCs and the disposal of residuals associated with groundwater monitoring and well installation (e.g., contaminated soil and groundwater, used personal protective equipment). In addition, restrictions could apply to water collected from separators and/or condensers, depending upon how they are managed. Water treated to MCLs does not trigger land disposal restrictions.

3.1.4.5 California Hazardous Waste Control Law

Transport of hazardous waste offsite for treatment or disposal must obtain and use a hazardous waste manifest and comply with Department of Transportation regulations (22 CCR, Div. 4.5, Chapter 12) and the federal DOT Hazardous Material Transport regulations (40 CFR Parts 262 and 263).

3.1.4.6 Occupational Safety and Health Administration Regulations

Activities conducted for implementing the soil remedy fall under the federal Occupational Safety and Health Administration (OSHA) regulations (29 CFR 1910.120) and California OSHA Hazardous Waste Operations and Emergency Response regulations (8 CCR 5192). Site activities would have to comply with these applicable regulations pertaining to personnel training, safety equipment, monitoring, construction activities such as well installation and trenching, and emergency response.

3.1.4.7 California Well Standards

The construction of remediation wells or monitoring wells or probes installed and later abandoned for the soil remedy will be conducted under the California Well Standards Bulletins 74-81 and 74-90 developed under the California Water Code 231. The Los Angeles County Health and Safety Code requirements are also applicable.

3.1.4.8 Local Agency Requirements

The implementation of the soil remedy will likely require permits from local agencies such as the city/county building, fire, engineering, and public works departments. Agencies that may be involved include the following: City of Whittier Planning and Building Departments for on-site activities, City of Whittier Public Works for off-site public right of way, Los Angeles County Fire Department, and South Coast Air Quality Management District. If a component of the selected remedy generates a wastewater stream that requires discharge to an industrial sewer, then appropriate permitting or modification of the existing Sanitation Districts of Los Angeles County permit may be required.

3.2 Remedial Action Objectives and Preliminary Remediation Goals

Remedial action objectives (RAOs) are medium-specific or site-specific objectives for protection of human health and the environment. Each RAO should specify the contaminants of concern, exposure routes and receptors, and the desired preservation or restoration of an environmental resource. The RA defined the specific levels at which contaminants no longer pose a human health or exposure risk. As such, these risk-based values provide a numerical standard that each remedial alternative developed in the FS must obtain to be considered protective.

The following RAOs have been developed for the contaminated onsite soils at OU-1:

- Reduce or eliminate the vapor intrusion risk associated with VOC vapors in contaminated soils.
- Reduce or eliminate the risk associated with direct exposure to, contact with and/or ingestion of contaminated soils.
- Reduce or eliminate contaminant migration to groundwater to levels that protect the groundwater resource.

The first two RAOs will be achieved by reducing VOC concentrations in soil and soil vapor to site-specific Preliminary Remediation Goals (PRGs), based on future residential land use, in the Final Human HHRA for On-Site Soils (CDM, November 9, 2007).

The third RAO will be achieved by reducing soil and soil vapor concentrations to levels that will be protective of the highest beneficial use of the aquifer; these specific cleanup levels will be determined during Remedial Design. In the event that the final groundwater remedy covering OU-1 does not require cleanup to achieve the aquifer's highest beneficial use, the cleanup levels for soil with respect to the third RAO will be revised to be consistent with such final groundwater remedy.

As described above, these RAOs have been developed to address soil and soil vapors at the site. Additional RAOs were developed for groundwater in 2005 in the Engineering Evaluation and Cost Analysis (EECA) study completed in July 2005 (CDM, 2005), which included ARARs for the selected groundwater remedy.

The preliminary remediation goals were defined in the HHRA to be the acceptable risk based levels that quantitatively define the RAOs. For PCE, these goals are as follows:

- Indoor Air (residential exposure scenario) - 0.33 ug/m^3

- Shallow Soil Gas (residential exposure scenario)) - 470 ug/m^3
- Soils (residential exposure scenario) – 1.2 mg/kg
- Outdoor air (industrial exposure scenario) - 0.77 ug/m^3

Regarding RAOs 1 and 2, the residential PRGs for soil and soil gas will apply to shallow soils (i.e., above 30 feet bgs). The use of residential PRGs may be re-evaluated if zoning of the area that includes OU-1 changes from commercial/residential to just commercial.

There is further discussion on the topic of estimating remediation times in subsection 6.2.

Table 3-1
Summary of Potential ARARs for Onsite Soils
Omega Chemical

Authority	Medium	Requirement	Status	Synopsis of Requirement
CHEMICAL-SPECIFIC CRITERIA				
Federal Regulatory Requirement	Groundwater	Federal Primary Drinking Water Standards 40 Code of Federal Regulations (CFR) Part 141	Relevant and Appropriate	Federal primary MCLs under the Safe Drinking Water Act (SDWA) protect the public from contaminants that may be found in drinking water. The onsite soils remedy is intended to mitigate potential or further degradation of ground water.
State Regulatory Requirement	Groundwater	California Primary Drinking Water Standards Health and Safety Code (H&S Code) §4010 *et seq.* 22 California Code of Regulations (CCR) §64431 and 64444	Relevant and Appropriate	California Primary MCLs protect public health from contaminants that may be found in drinking water sources and are at least as stringent as the federal standard. The onsite soils remedy is intended to mitigate potential or further degradation of ground water.
State Regulatory Requirement	Groundwater	California Water Code §13240 et seq. (portions, as identified under the fifth column "Synopsis of Requirement") Water Quality Control Plan for Los Angeles region (adopted 11/19/92) California Water Code §13240 et seq.	Relevant and Appropriate	Establishes beneficial uses of ground and surface waters; establishes water quality objectives and implementation plans to meet water quality objectives (WQOs) and protect beneficial uses; incorporates statewide water quality control plans and policies. The WQOs for groundwater are based on the primary MCLs. The Los Angeles plan designated the beneficial uses of groundwater in the Los Angeles coastal plain to be municipal and domestic, agricultural, industrial service, and industrial process supplies. Only those parts of the Basin Plan that set out the designated uses (beneficial uses) and the water quality criteria based upon such uses (water quality objectives) meet the NCP's definition of substantive standards. The following portions of the Basin Plan are substantive: Water Quality Control Plan, Los Angeles Region (Basin

Table 3-1
Summary of Potential ARARs for Onsite Soils
Omega Chemical

Authority	Medium	Requirement	Status	Synopsis of Requirement
				Plan), Chapter II, Ground Waters: Unless otherwise designated by the Regional Water Board, all ground waters in the Region are considered suitable or, at a minimum, potentially suitable, for municipal and domestic water supply (MUN), agricultural supply (AGR), industrial service supply (IND), and industrial process supply (PRO). Basin Plan, Chapter III, Water Quality Objectives for Ground Waters, Chemical Constituents: Ground waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum, groundwater designated for use as MUN shall not contain chemical constituents in excess of the MCLs specified in Title 22. To protect all beneficial uses, the Regional Water Board may apply limits more stringent than MCLs. Toxicity: Groundwater shall be maintained free of toxic substances in concentrations that produce detrimental physiological response in human, plant, animal, or aquatic life associated with designated beneficial uses. Tastes and Odors: Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.
State Regulatory Requirement	Groundwater	State Water Resources Control Board (SWRCB) Resolution No. 92-49 III.G Policy and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304 (amended 4/21/94) California Water Code§13307 23 CCR§2550.4	Relevant and Appropriate	To protect groundwater, the resolution requires cleanup to either background water quality or the best water quality that is reasonable if background water quality that is reasonable if background water quality cannot be restored. Non-background cleanup levels must be consistent with maximum benefit to the public, present and anticipated future beneficial uses, and conform to water quality control plans and policies.
State Regulatory Requirement	Groundwater and soil	Title 23 California Code of Regulations, Division 3, Chapter 15, Article 5, Section 2550	Applicable	Monitoring requirements for waste management units, including unauthorized waste discharges to land, and establishes water quality protection standards for corrective action including concentration limits for constituents of concern at background levels unless infeasible to achieve. Cleanup levels greater than background must be the lowest

Table 3-1
Summary of Potential ARARs for Onsite Soils
Omega Chemical

Authority	Medium	Requirement	Status	Synopsis of Requirement
				economically and technologically achievable, must consider exposure to other media, and must consider combined toxicologic effects of pollutants.
State Regulatory Requirement	Groundwater and soil	DTSC Hazardous Waste Regulations Hazardous Waste Definition Standards Title 22 California Code of Regulations, Division 4.5, Chapter 11 (22 CCR 66261.24) Non-hazardous waste Cal. Code Regs. Title 27 20210, 20220, 20230	Applicable	Contaminated media once extracted for treatment, must be managed as state & federal hazardous waste if such media contains levels of hazardous substances that meet or exceed state and federal hazardous waste criteria. Applicable for waste generated onsite such as, but not limited to:soil vapor, excavated soil, or soil cuttings.
ACTION-SPECIFIC CRITERIA				
Federal Regulatory Requirement	Groundwater	National Pollutant Discharge Elimination System (NPDES) Clean Water Act (CWA) § 402 *et seq.*	Applicable	The NPDES requirements are applied to point and non-point discharge sources. Substantive requirements including the establishment of discharge limitations, monitoring requirements, and best management practices (BMPs) for surface water discharges. Applicable to the control of contaminants to storm water runoff from a treatment plant construction site and groundwater treatment systems.
Federal and State Regulatory Requirement	Groundwater	NPDES Point Source Discharge 40 CFR 122-125	Applicable	The substantive provisions of an NPDES permit for discharges to a State body of water i.e. waste discharge requirements, will apply if the treated water is discharged to the San Gabriel river.
State Regulatory Requirement	Groundwater and soil	SWRCB Resolution 68-16 Statement of Policy with Respect to Maintaining High Quality of Waters in	Relevant and Appropriate	Under the State's Antidegradation Policy as set forth in State Board resolution 68-16, an antidegradation policy applies to the establishment of cleanup levels for groundwater and for soils which threaten water quality.

Table 3-1
Summary of Potential ARARs for Onsite Soils
Omega Chemical

Authority	Medium	Requirement	Status	Synopsis of Requirement
		California Water Code § 13140		Remedial alternatives for the onsite soils would require cleanup levels for soil to be protective of beneficial uses of the groundwater.
State Regulatory Requirement	Soil	California Water Code §13140-13147,13172,13260, 13263, 132267, 13304 27 CCR Div. 2, Subdiv. 1, Chap. 3, Subchap. 2, Art. 2 (27 CCR §§ 20200, 20210, 20220, 20230)	Applicable	Wastes classified as a threat to water quality (designated waste) may be discharged to a Class I hazardous waste or Class II designated waste management unit. Nonhazardous solid waste may be discharged to a Class I, II, or III, waste management unit. Inert waste would not be required to be discharged into a SWRCB-classified waste management unit (27 CCR §20200 et seq.). The requirement is relevant because CERCLA waste as a result of investigation-derived waste may be generated and would be disposed at a EPA Region IX approved facility in accordance with CERCLA.
State Regulatory Requirement	Groundwater	Water Quality Control Plan Porter-Cologne Water Quality Control Act SWRCB Resolution No. 88-63 Sources of Drinking Water	Applicable	This policy specifies that ground and surface waters of the state are either existing or potential sources of municipal and domestic supply except water supplies with: Total dissolved solids exceeding 3,000 milligrams per liter, or Natural or anthropogenic contamination (unrelated to a specific pollution incident) that cannot reasonably be treated for domestic use using either BMPs or best economically achievable treatment practices, or The water source does not provide a sustained yield of 200 gallons per day. Groundwater underlying the Site meets the criteria as a potential source for drinking water.
State Regulatory Requirement	Soil and Groundwater	California Hazardous Waste Control Law H&S Code Div. 20, Chap. 6.5 Identification and Listing of Hazardous Waste 22 CCR Div. 4.5, 22 CCR §66264.13	Applicable	A generator must determine if the waste is classified as a hazardous waste in accordance with the criteria provided in these requirements. Waste characteristics of treated soil and groundwater will be defined prior to treatment and disposal. This methodology to characterize waste at the Site may identify some of the waste at the Site meet the characteristics of hazardous waste. Any subsequent hazardous waste requirement would be relevant and appropriate.

Table 3-1
Summary of Potential ARARs for Onsite Soils
Omega Chemical

Authority	Medium	Requirement	Status	Synopsis of Requirement
		22 CCR §66260.200		
Federal and State Regulatory Requirement	Soil and Groundwater	Hazardous Waste Regulations Accumulation Time 22 CCR §66262.34	Substantive provisions are applicable if waste is determined to be RCRA hazardous waste.	Onsite hazardous waste accumulation is allowed for up to 90 days as long as the waste is stored in containers or tanks, on drip pads, inside buildings, is labeled and dated, etc.
Federal and State Regulatory Requirement	Soil and Groundwater	Preparedness and Prevention 22 CCR Div. 4.5, Chap. 14, Art. 3	Applicable	Facility design and operation to minimize potential fire, explosion, or unauthorized release of hazardous waste.
Federal and State Regulatory Requirement	Groundwater	Hazardous Waste Regulations Water Quality Monitoring and Response Systems for Permitted Systems 22 CCR Div. 4.5, Chap. 14, Art. 6	Applicable	The requirements present the groundwater monitoring system objectives and standards to evaluate the effectiveness of the corrective action program (remedial activities). This requirement is similar to 27 CCR §20410. Groundwater monitoring considered for the remedial alternatives
Federal and State Regulatory Requirement	Soil and groundwater	Use and Management of Containers 22 CCR Div. 4.5, Chap. 14, Art. 9	Substantive provisions are applicable if waste is determined to be RCRA hazardous waste.	Maintain container and dispose to a Class I hazardous waste disposal facility within 90 days. Storage of investigation-derived waste (i.e., soil cuttings and well development) will be generated. Requirements may apply for the storage of contaminated groundwater and sediments trapped by the bag filter during start-up operation. The 90-day storage limit is to not create a greater environmental hazard than already exists.
Federal and State Regulatory Requirement	Groundwater	Tank Systems 22 CCR Div. 4.5, Chap. 14, Art. 10	Applicable	Minimum design standards (i.e., shell strength, foundation, structural support, pressure controls, seismic considerations) for tank and ancillary equipment are established. The requirements for minimum shell thickness and pressure controls to prevent collapse or rupture is to not create a greater environmental hazard than already exists.
State Regulatory Requirement	Soil and Groundwater	Miscellaneous Units Requirements 22 CCR Div. 4.5, Chap. 14, Art. 16 22 CCR §66264.601 - 66264.603	Applicable	Minimum performance standards are established for miscellaneous equipment to protect health and the environment. Treatment of hazardous waste through an air stripper or granulated activated carbon (GAC) would qualify as a RCRA miscellaneous unit if the contaminated water constituted a hazardous waste. Therefore, the substantive requirements for miscellaneous units and related

Table 3-1
Summary of Potential ARARs for Onsite Soils
Omega Chemical

Authority	Medium	Requirement	Status	Synopsis of Requirement
				substantive closure requirements may be relevant and appropriate for the Site.
State Regulatory Requirement	Air	South Coast Air Quality Management District (SCAQMD) Regulation IV, Rule 1401, Visible Emissions.	Applicable	The SCAQMD regulations are established to achieve and maintain state and federal ambient air quality standards through the federal-approved state implementation plan (SIP). A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health, or safety of any such persons or the public or which cause to have a natural tendency to cause injury or damage to business or property.
State Regulatory Requirement	Air	Regulation IV, Rule 402, Nuisance	Applicable	A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health, or safety of any such persons or the public or which cause to have a natural tendency to cause injury or damage to business or property.
State Regulatory Requirement	Air	Regulation IV, Rule 403, Fugitive Dust	Applicable	Emissions of fugitive dust shall not remain visible in the atmosphere beyond the property line of the emission source. Activities conducted in the South Coast Air Basin shall use best available control measures to minimize fugitive dust emissions and take necessary steps to prevent the track-out of bulk material onto public paved roadways as a result of their operations.

Table 3-1
Summary of Potential ARARs for Onsite Soils
Omega Chemical

Authority	Medium	Requirement	Status	Synopsis of Requirement
State Regulatory Requirement	Air	Regulation IV, Rule 404, Particulate Matter – Concentration.	Applicable	Particulate matter in excess of the concentration standard conditions shall not be discharged from any source. Particulate matter in excess of 450 milligrams per cubic meter (0.196 grain per cubic foot) in discharged gas, calculated as dry gas at standard conditions, shall not be discharged to the atmosphere from any source.
State Regulatory Requirement	Air	Regulation IV, Rule 301	Applicable	Applicable for treatment alternatives where vapors will be emitted to the atmosphere. Any air stripping and soil vapor extraction operations that emit vapors shall comply with emissions requirements.
State Regulatory Requirement	Air	Regulation IV, Rule 1166	Applicable	Applicable for soil excavation, including trenching for system lines. Any soil grading excavation, or handling of volatile organic compound contaminated soil shall be permitted and comply with emissions requirements.
State Regulatory Requirement	Soil and groundwater	Land Use Covenant California Civil Code section 12471, California Health and Safety Code section 25355.5, California Code of Regulations, Title 22, section 67391.1 Civil Code Section 1471	Relevant and appropriate	If hazardous materials, hazardous wastes or constituents, or hazardous substances will remain at the property after implementation of the remedy at levels which are not suitable for unrestricted use of the land, this requirement would be relevant and appropriate.

Table 3-2
Summary of TBCs for Onsite Soils
Omega Chemical

TO-BE-CONSIDERED (TBC) CRITERIA				
Authority	**Medium**	**Requirement**	**Status**	**Synopsis of Requirement**
State Guidance	Groundwater	A Compilation of Water Quality Goals (August 2000 ed.)	TBC	Provides guidance on selecting numerical values to implement narrative water quality objectives contained in the Basin Plan.
State Guidance	Groundwater	The Designated Level Methodology for Waste Classification and Cleanup Level Determination	TBC	Provides guidance on how to classify wastes to meet SWRCB hazardous waste management requirements (23 CCR Div.3, Chap.15, Art.2) and designated, nonhazardous, and inert waste management requirements (27 CCR Div.2, Subdiv.1, Chap.3, Subchap.2, Art.2).
State Guidance	Groundwater	California Action Levels	TBC	Action Levels (ALs) are health-based advisory levels established by the California Department of Health Services for contaminants that lack primary MCLs. ALs are advisory levels and not enforceable standards. An AL is the level of a contaminant in drinking water that is considered not to pose a significant health risk to people ingesting that water on a daily basis. It is calculated using standard risk assessment methods for noncancer and cancer endpoints, and typical exposure assumptions, including a 2-liter per day ingestion rate, a 70-kilogram adult body weight, and a 70-year lifetime. For 1,4-dioxane, a chemical considered a probable carcinogen and a COC at the Site, the AL is generally a level considered to pose "de minimis" risk (i.e., a theoretical lifetime increase in risk of up to one excess case of cancer in a population of 1,000,000 people—the 10E-6 risk level).
State Guidance	Soil and Groundwater	California Well Standards California Department of Water Resources Bulletin 74-90	TBC	This is a supplement to Bulletin 74-81(domestic water well standards) that address minimum specifications for monitoring wells, extractions wells, injection wells, and exploratory borings. Design and construction specifications are considered for construction and destruction of wells and borings.
State Guidance	Soil, Soil Gas and Indoor Air	California Human Health Screening Levels	TBC	California Human Health Screening Levels (CHHSLs) -Cal/EPA has developed "screening values" for 54 hazardous substances that are typically found at brownfields sites. These values serve as reference numbers to help developers and local governments estimate the costs and extent of cleanup of contaminated sites, providing valuable information in their development decisions.

Section 4
Identification and Screening of General Response Actions, Technologies, and Process Options

General response actions (GRAs) are actions that will satisfy the RAOs outlined in Section 3.3. They serve as a screening level remedial alternative that is proposed and then refined as the feasibility process proceeds and therefore, must meet NCP criteria for an alternative. GRAs, which are media-specific, may include treatment, containment, excavation, extraction, disposal, or any combinations of these.

4.1 GRAs for Omega Onsite Soils

The following GRAs are proposed for the contaminated soils and soil gas at OU1.

- No action
- Institutional Controls
- Containment
- Extraction/Treatment/Disposal
- *In Situ* Treatment

Each GRA is described in detail in the following sections.

4.1.1 No Action

A no action response is not appropriate for OU1 since ARARs and RAOs are not met by current conditions. However, the NCP requires that a no action alternative be carried through the FS process to provide a baseline for evaluating all other remedial alternatives.

4.1.2 Institutional Controls

Institutional controls (ICs) represent non-engineered administrative or legal controls that limit land or resource use. ICs can be a stand-alone remedy or can serve as a supplement to an engineered remedial action throughout all stages of the cleanup process. ICs can stand alone or be incorporated as a layered component of the cleanup process to provide overlapping remedies.

4.1.3 Containment

The containment GRA involves the installation of a horizontal barrier between contaminated soils and potential receptors to mitigate exposure to surface soils and shallow soil vapor. Capping areas of a site containing contaminated soils and soil gas at levels that pose a risk to human health and the environment is the standard means of installing a horizontal barrier. In addition, capping unpaved areas reduces the infiltration of precipitation, thereby decreasing the movement of vadose zone contaminants to the water table.

4.1.4 Extraction/Treatment/ Disposal

Under this GRA, contaminated soils posing a risk to human health are excavated, treated after removal (if required), and transported to an appropriate disposal area. Excavated areas are replaced with clean imported fill material and covered with an appropriate material selected based on future land use. Treatment options for excavated material include stabilization, immobilization, physical, or chemical treatment. Disposal of excavated and treated material may be in either onsite engineered repository or in an appropriate offsite disposal facility.

4.1.5 *In Situ* Treatment

The *in situ* treatment GRA involves the reduction of COCs in contaminated soils and soil gas through installation of a treatment cell within the contaminated soil. This treatment cell can provide chemical, physical, thermal, or biological treatment of the soil and soil vapor contaminants.

4.2 Identification and Screening of Technologies and Process Options

In this section, representative treatment technologies for each GRA are selected and screened for inclusion in remedial alternatives.

4.2.1 Identification of Technologies and Process Options

In this sub-section, representative process options or technologies are identified for each of the GRAs selected for OU1.

4.2.1.1 Institutional Controls

For OU1, potential IC components include the following:

- Construction restrictions limiting the disturbance of surface and shallow soils
- Requirements for personal protective equipment to be worn by onsite workers installing or checking utilities that would require disturbance of surface and subsurface soils
- A deed restriction may be implemented such that future activity at the site is compatible with the presence of chemicals in the subsurface. In this case, the restrictions could preclude certain uses of the property.

4.2.1.2 Containment

The capping process option would involve installation of cover over unpaved areas of the Phase 1a area. Capping options can vary from a simple cover of clean fill material to a multi-layered engineered cover. The cap can be designed to be either permeable or impermeable to surface water and surface water run on. Cap design would include contouring and grading of surface prior to cap installation to control surface water run on/run off at capped areas and to reduce exposure to shallow soils and shallow soil vapor.

4.2.1.3 Excavation/Treatment/Disposal

Potential excavation, treatment, and disposal options for OU1 soils are presented below:

Excavation
Excavation would be conducted using conventional excavation methods to a protective depth determined by risk-based levels, exposure pathways, and future land use scenarios. Excavation can either be performed site-wide or can be focused to address areas of highest exposure risk.

Ex Situ Treatment
Ex situ treatment can either be performed onsite, or at an appropriate offsite disposal facility. Due to the wide range of contaminants in the soils, however, treatment options that would be most effective would be limited to thermal options such as incineration, pyrolosis, or thermal desorption.

Disposal
Once the excavated material has undergone treatment (if necessary), it can be placed in an appropriate landfill for offsite disposal.

4.2.1.4 *In Situ* Treatment

Potential technologies for *in situ* remediation of soils at OU1 are presented below:

Chemical
Chemical process options for *in situ* treatment include chemical oxidation, soil flushing, and chemical fixation. Chemical oxidation involves injection of a strong oxidizing agent such as hydrogen peroxide, sodium persulfate or sodium permanganate through a series of injection wells and or trenches located in hot spot areas. These oxidizing agents cause the rapid chemical degradation of some COCs. Soil flushing involves injection of a solvent mixture into the vadose or capillary fringe zones. Contaminants are then flushed from the soil into the solvent mixture and extracted downgradient of the injection wells. The solvent mixture is extracted, treated above ground, and recycled if possible.

Physical
Physical process options for *in situ* treatment include soil vapor extraction (SVE) and fracturing. SVE removes VOCs and some semi-volatile organic compounds (SVOCs) from vadose zone and capillary fringe soils using vacuum blowers and vapor extraction wells. The contaminated vapor is collected at the surface and is treated and/or discharged to the atmosphere. The induced advection of air draws clean air through the contaminated vadose zone, promoting transfer of contaminants from the

subsurface soil matrix to the vapor phase. SVE can be installed as a site-wide measure or can be confined to areas of highest contamination.

Fracturing, using either hydraulic or pneumatic pressures, creates pathways in the soil matrix that increase the permeability of soils. Fracturing is not a stand-alone option, but is used with other *in situ* treatment to increase efficiency of the overall process.

Thermal

Thermal *in situ* treatment is not a stand alone option, but is used in conjunction with a SVE system to increase the efficiency of VOC removal. Thermal treatment introduces a heat source into the soil matrix, stripping VOCs from the soil that are removed and treated through the SVE system. Heat source options include electrical resistance heating, radio frequency electromagnetic heating, steam injection, hot air injection, and conductive heating.

Biological

In situ biological technologies involve addition of gasses and/or nutrients (and sometimes microorganisms) to the subsurface to stimulate biodegradation of contaminants by creating a favorable environment for the proliferation of microorganisms. Microbial degradation can be either aerobic or anaerobic. The success of a bioremediation process option is driven by the pH, temperature, redox conditions and site hydrology coupled with the conditions required for biodegradation of a given contaminant. For example, most chemicals degrade more rapidly and completely under aerobic conditions; however, contaminants such as PCE require anaerobic conditions to biodegrade.

4.2.2 Screening of Potentially Applicable Technologies and Process Options

In this section, the remedial technologies and process options presented in Section 4.2.1 are evaluated through a two-step screening process. First, technology types and process options are evaluated based on technical implementability. This is a general screening to eliminate options that can not be implemented due to site-wide conditions identified in the RI.

Technology types and process options that are technically implementable are then screened for effectiveness, implementability, and cost. These are broad screening criteria applied to how the technology or process option meets the GRA it represents. Screening at this point in the process is more focused on effectiveness than on implementability and cost evaluations.

4.2.2.1 SVE Pilot Testing

SVE pilot testing was initiated in the former Three Kings Construction parking lot on October 17, 2006. The test followed the procedures specified in the *Soil Vapor Extraction Pilot Test Work Plan* (CDM, 2006).

The initial test utilized a total of 10 SVE wells arranged in five groups of two wells. Each group had a well screened from 12 to 22 feet bgs (SVE-1S through SVE-5S) and a well screened from 26 to 36 feet bgs (SVE-1M through SVE-5M). The testing began by performing a step test on each of the wells, where three different levels of vacuum were applied and the resulting vapor extraction rate and subsurface vacuum distribution were measured at each step. Multi-week testing followed the initial step testing. In addition, field measurements of the total VOC concentration in the extracted vapors were taken and samples of these vapors were periodically collected for off-site laboratory analysis. The initial testing results and findings were presented in the *Technical Memorandum for Soil Vapor Extraction Pilot Test Initial Findings* (CDM, February 5, 2007).

The expanded SVE pilot testing utilized a total of 3 SVE (SVE-6S through SVE-8S) wells and 6 VMPs (VMP-1 through VMP-6). The expanded testing consisted of pneumatic communication testing, step testing, and multi-week extended testing. Field measurements of the total VOC concentration in the extracted vapors were taken and samples of these vapors were periodically collected for off-site laboratory analysis. The expanded testing results and findings were presented in the Technical *Memorandum Expanded Soil Vapor Extraction Pilot Test Findings* (CDM, August 31, 2007).

The initial and expanded SVE pilot testing findings and conclusions are summarized below:

- SVE is a feasible technology to remediate onsite vadose zone soils.

- Radius of influence ranging from at least 48 feet to at least 77 feet was achieved when vacuum ranging from 4 to 10 inches of mercury (Hg) was applied at the various locations. Vapor extraction flow rates ranged from 50 to 145 standard cubic feet per minute at the various locations.

- The vadose zone above the 30-foot unit can be addressed with SVE wells screened from approximately 10 to 25 feet bgs (i.e., the two screened intervals used for the initial testing are not needed).

- Evaluation of the pneumatic communication testing results during the expanded testing indicated that pneumatic communication occurs across the 30-foot unit.

- Total VOC concentrations in extracted vapors typically ranged from 200 to 900 parts per million volume (ppmv) and increased in locations closest to the Star City Auto Body building. The concentrations of VOCs in extracted vapors from the three Star City Auto Body wells, coupled with the time trend in these wells, indicate a strong source of VOCs at this location.

- During the initial testing, VOC mass removal rates ranged from 2 to 84 pounds per day, depending on the SVE well operated. A total of 415 pounds of VOCs were removed during the initial testing.

- During the expanded testing, VOC mass removal rates ranged from 35 to 53 pounds per day, depending on the SVE well operated. A total of 817 pounds of VOCs were removed during the expanded testing.

- The GAC treatment units were capable of removing the VOCs found in the extracted soil vapors. The analyses of the samples that were collected at the GAC units provided a basis to evaluate and design GAC treatment for a potential full-scale SVE system, if appropriate.

While the pilot test was performed in the shallow vadose zone (above the 30-foot unit), due to the similarity in soil type in the deep vadose zone (as indicated by the numerous borehole and MIP logs), the pilot test results are assumed to apply to the deep and the shallow portions of the vadose zone. Therefore, the conceptual layout of the deep SVE wells has been based on the pilot test data from shallower soils.

The *Technical Memorandum for Soil Vapor Extraction Pilot Test Initial Findings* (CDM, February 5, 2007), the *Revised Second Addendum to February 5, 2007 Technical Memorandum* (CDM, April 20, 2007), and the *Technical Memorandum Expanded Soil Vapor Extraction Pilot Test Findings* (CDM, August 31, 2007), as well as USEPA's comment letters and OPOG's responses to comments, where available, were provided in their entirety on a compact disc in Appendix B of the RI report.

4.2.2.2 Technical Implementability Screening

For OU1 soils, the following technologies or process options are considered technically impracticable:

Onsite disposal
The existing and future use plans for the site do not support construction of an onsite repository (i.e., zoning of the land does not support such land use). Therefore, onsite disposal is not retained as a process option.

In Situ Bioremediation
While bioremediation is a viable treatment option for many sites with soil contamination, the wide variety of contaminants at OU1 would require both anaerobic and aerobic conditions for successful bioremediation of all COCs. Since both aerobic and anaerobic conditions do not co-exist, *in situ* bioremediation is not considered technically implementable at OU1.

4.2.2.3 Effectiveness, Implementability, and Cost Screening

Each of the remaining process options are evaluated for effectiveness, implementability, and cost using the definitions of each criterion presented below. The technology evaluations are based on information contained in the *Treatment Technologies Screening Matrix* (EPA 2004) based on the information from annual status reports (ASR) on technologies maintained through EPA's technology innovation program (TIP).

Effectiveness
The effectiveness evaluation of each process option is based on its ability to address the following concerns:

- Potential impacts to human health and the environment during implementation
- How proven the technology is with respect to the contaminants and conditions at the site

Implementability
Technically implementable process options are evaluated with respect to the institutional aspects of implementability, such as the ability to obtain permits for offsite disposal of treated groundwater if required; the availability of treatment, storage, and disposal services; and the availability of necessary equipment and skilled workers.

Cost
The cost of a process option is evaluated at this point in the process based on engineering judgment and is ranked as high, moderate, or low relative to other process options in the same technology type. The ranking is inversely related to cost.

Screening Results
The results of the screening of process options and technologies are presented in Table 4-1 and discussed below:

Institutional Controls
As a stand alone process option, ICs may limit exposure to hazardous substances; however , as provided in section 400.430(a)(1(iii)(D) of the National Contingency Plan, the use of ICs shall not substitute for active response measures as the sole remedy unless active measures are determined not to be practicable. Based on the other viable active measures identified in this report, ICs will not be carried through the FS process as a stand alone option. However, ICs will provide a measure of long term effectiveness when included as a component for remedial alternatives developed for OU1. Therefore, ICs may be combined with other retained process options as part of a proposed remedial action alternative.

Containment
Installation of a low permeability cap over the unpaved areas of the Phase 1a area would be effective in meeting the RAOs requiring prevention of exposure from contaminated soils and soil gases to commercial workers. Capping would minimize infiltration from surface water through contaminated soils and subsequently reduce contaminant loading into groundwater. Capping can change the pathways over which soil vapors migrate in the vadose zone and could therefore have an impact on indoor air quality at locations where a vapor intrusion pathway is complete.

Since the low permeability cap design would utilize easily obtainable materials and could be installed by using conventional construction methods, it would be easy to implement. The cost of a low permeability cap system throughout the unpaved areas of the Phase 1a area would be a moderate to high cost process option. Therefore, based on high effectiveness, ease of implementation, and low to moderate costs, capping will be carried through the development of alternatives step of the FS process.

Excavation/Onsite Thermal Treatment/Offsite Disposal

Excavation, treatment, and disposal of shallow contaminated soils from the site would be a partially effective means of achieving RAOs. Excavation of shallow soils would require standard construction practices utilizing easily available equipment and would therefore be implementable. Excavation of mid-depth soils (25 to 50 feet) may require special construction practices, particularly if buildings are present adjacent to the excavation. Excavation of deep soils (e.g., greater than 50 feet) is generally not practical. Disposal in an appropriate offsite facility would be effective and easy to implement, but might incur moderate transportation costs. Therefore, excavation, and offsite disposal process options will be carried through the development of alternatives step of the FS process.

Onsite thermal treatment equipment is easily obtained and easily installed onsite. However, thermal treatment of the volume of soils requiring excavation would be difficult to implement. The amount of area required for stock piling both treated and untreated soils would interfere with the operations of the business tenants on the site. Thermal treatment options traditionally have high capital and O&M costs associated with installation and ongoing operation. The thermal treatment trains may require ancillary off gas treatment to meet both California air quality and Toxic Substances Control Act (TSCA) standards for emissions of dioxins. This additional treatment train would add cost to an already expensive alternative. Therefore, based on low implementability and high cost, the treatment process option will not be carried forward in the FS. Treatment required for excavated soils to meet land disposal restrictions (LDRs) would be provided at an appropriate landfill.

In Situ Chemical Treatment

In situ chemical oxidation and soil flushing are only moderately effective in meeting RAOs through treatment of the varied contaminants found in the soils at the site. Through utilization of wells as the injection and extraction wells in both an oxidation and soil flushing system, these process options would be easy to implement. However, the amount of oxidizing agent or flushing solvents required for successful *in situ* remediation from either process option can lead to high on-going O&M costs. Also, not all COCs would be treated with chemical oxidation (e.g., chlorinated ethanes). Based on the high relative cost and moderate effectiveness, *in situ* chemical oxidation and soil flushing will not be carried forward in the FS process.

In Situ Physical Treatment

Pilot testing has confirmed that SVE is highly effective in treatment of all the volatile COCs found in the soils at the site. SVE would be effective in meeting RAOs when implemented either site-wide or in hot spot or source areas. Installation of wells for

SVE would not require exotic drilling methods based on site lithology and vapor treatment would utilize easily obtained equipment. Therefore, SVE is considered highly implementable. While SVE can have moderate ongoing O&M costs, the shorter required treatment times help minimize the impact of this cost component. Therefore, SVE will be carried through the development of alternatives step of the FS process.

Thermal treatment could be used to enhance the effectiveness of SVE performance, thereby shortening the time required to achieve soil cleanup goals. Therefore, *in situ* thermal process options will be carried forward in the FS process as a SVE enhancement. Similarly, passive air injection, active hot air injection and dual phase extraction (DPE) can be used as SVE enhancements.

DPE is an *in situ* remediation technology for simultaneous extraction of different phases of contaminants, including vapor phase, dissolved phase, and separate phase contaminants from vadose zone, capillary fringe, and saturated zone soils and groundwater. It is a modification of SVE and is most commonly applied in moderately permeable soils. In DPE, soil gas and liquids are conveyed from the extraction well to the surface in separate conduits by separate pumps or blowers. The process utilizes a submersible pump suspended within the well casing that extracts liquid, which may be NAPL and/or groundwater, and delivers it to an aboveground treatment and disposal system. Soil gas is simultaneously extracted by applying a vacuum at the wellhead. The extracted gas is conveyed to a gas-liquid separator prior to gas phase treatment. DPE is in essence a rather straightforward enhancement of SVE, with groundwater recovery being carried out within the SVE well. Application of a vacuum to the well also enhances dewatering of the soils surrounding the well. Other DPE configurations are also common, such as use of high vacuum to a drop tube to remove liquids from the well rather than use of a submersible pump.

DPE is retained as a technology that could be used to enhance SVE. The enhancement would likely be due to two effects: 1) DPE would lower the water table elevation, thereby counteracting the rise in water table that may occur in the vicinity of a deep SVE well; and 2) DPE would reduce groundwater VOC concentrations in shallow groundwater, thereby decreasing off-gassing of VOCs to the deep vadose zone.

4.3 Summary of Retained Process Options

The following process options are retained for development into remedial action alternatives:

- No Action
- Institutional Controls
- Capping
- Excavation of Shallow Soils

- Offsite Soil Disposal
- SVE
- Thermally Enhanced SVE

Table 4-1
Screening of Soil Remediation Technologies and Process Options
Omega Chemical Feasibility Study

General Response Action	Remedial Technology	Process Option	Description	Effectiveness	Implementability	Relative Cost	Screening Comments	Retained Y/N
Institutional Controls	Institutional Controls	Institutional Controls	ICs will include building restrictions prohibiting the disturbance of surface and shallow soils, PPE requirements for future construction workers, and ongoing monitoring.	Moderate	High	Low	While ICs are not effective as a stand alone remedy, they are effective when included as components in an alternative. Specific IC's will be discussed later in this FS.	Y
Containment	Physical Containment	Engineered Surface Cap	Installation of an impermeable cap over areas of potential exposure to eliminated exposure pathway and to prevent infiltration of rainfall.	Moderate	High	Low	An impermeable cover will be effective in eliminating exposure to both soil and soil gas contamination while minimizing the infiltration of rainfall. However, this effectiveness is dependent upon ICs that prohibit breaching the cover during future activities on Site.	Y
Excavation	Excavation	Excavation	Conduct limited excavation of impacted vadose zone soil to or above water table.	High	Low	High	Excavation and off site disposal of impacted soil material is effective in preventing exposure. However, if the depth of excavation exceeds 10 feet, shoring and ramps are required for equipment access. In addition, workers may require level C PPE due to contaminant exposure. These factors make excavation difficult to implement.	Y
Soil Treatment	In-Situ Treatment	Soil Vapor Extraction (SVE)	Extract soil vapor from vertical wells screened within the contaminated vadose zone. Treat extracted vapors at the surface.	High	Moderate	Moderate	SVE was proven effective in treating COCs at Site during pilot testing.	Y
		Dual Phase Extraction (DPE)	Extract soil vapor from vertical wells screened within the contaminated vadose zone and capillary fringe zone accessed through groundwater extraction. Treat extracted vapors at the surface. Treat extracted groundwater through the Omega groundwater treatment system.	High	Moderate	Moderate	Because the SVE system was proven effective in treating COCs at Site during pilot testing, DPE will only be considered as an enhancement of SVE operations should operations of full scale SVE systems require enhancement.	
		Soil Flushing	Flush contaminants into the saturated zone with surfactants for organics. Extract contaminated groundwater and treat at surface.	Moderate	Low	High	Soil flushing has a limited effectiveness when implemented in low permeability or heterogeneous soils. Recovery of surfactant/COC mixture would be difficult under Site conditions.	N
		Soil Fracturing	Using either pneumatic or hydraulics fracturing of the soil matrix, increasing the radius of influence of in-situ treatment. Used as an enhancing method for other technologies.	Low	Low	Moderate	Pilot studies of SVE demonstrated no need for fracturing to expand radius of influence of SVE wells.	N
		Chemical Oxidation	Injection of strong oxidizing agent into soil matrix to promote chemical degradation of COCs.	Low	Moderate	High	Would not be effective in treatment of chlorinated ethanes or freons. Cost of oxidizing agent and delivery methods contribute to high costs.	N
		Vitrification	Heat soil to melting point which will destroy or volatilize COCs.	Moderate	Low	High	Would not be effective in treatment of VOCs.	N

Notes:

Under each of the Screening Criteria, the Process Options were rated Low, Moderate, or High:

1. Effectiveness focuses on a) potential impacts to human health and the environment during the construction and implementation phase and b) reliability and proven history of the technology types or process options with respect to the detected hazardous substances and conditions at the Site .
2. Implementability is defined as the technical and institutional feasibility of implementing a technology type or process option.
3. Cost refers to relative capital, operations, and maintenance costs based on the engineer's opinion, within each Remedial Technology subset.

CDM

Process options are rated on a stand alone basis in this step of the FS process. When combined with other process options as part of a proposed remedial action alternative, the alternative may be ranked higher than each individual option.

Table 4-1 (cont.)
Screening of Soil Remediation Technologies and Process Options
Omega Chemical Feasibility Study

General Response Action	Remedial Technology	Process Option	Description	Effectiveness	Implementability	Relative Cost	Screening Comments	Retained Y/N
		Thermal Treatment	Heat soil through hot air injection, steam injection, electrical resistance heating (ERH), radio frequency, or thermal conduction to volatilize VOCs. Used to enhance SVE.	High	Moderate	High	Thermal treatment can be used to enhance SVE operations. Radio frequency can cause interference issues with wireless transmissions near the site. Steam injection would be difficult in the fine grained lithologies at the site and no available sources of high pressure steam are adjacent to the Site. Therefore only hot air injection, conductive and ERH options for thermal treatment will be carried through into the alternatives as either components of the alternatives or options to consider for use as SVE enhancements if required.	Y
	Ex-Situ Treatment	Incineration	Incinerate excavated soils to combust VOCs and SVOCs.	High	Moderate	High	The incineration of soils containing SVOCs and VOCs would require an additional treatment train to meet California emissions standards in incineration off gas. The incineration of freons could produce dioxins as well. The cost of incineration coupled with excavation costs would be prohibitive. Stockpiling of excavated material would also be difficult to implement.	N
		Pyrolysis	Chemical decomposition at less than stoichiometric quantities of oxygen through rotary kiln, rotary hearth furnace, or fluidized bed furnace.	Low	Low	High	Pyrolysis would only be highly effective with SVOCs. High O&M costs of pyrolosis are compounded by the high costs of excavation and soil stockpiling prior to pyrolosis.	N
		Thermal Desorption	Excavated soils are heated to 300 to 100 F and vaporized COCs are swept into an inert carrier gas. The gas is then treated, usually through an afterburner.	High	Moderate	High	The costs of thermal desorption coupled with excavation costs would be prohibitive. Stockpiling excavated material for treatment would also be difficult to implement.	N
Disposal	Disposal	Off Site	Transport excavated soil to a landfill permitted to accept the waste.	High	High	High	Disposal at an out-of-state facility may be more cost effective than achieving the higher treatment standards for in-state facilities.	Y

Notes:

Under each of the Screening Criteria, the Process Options were rated Low, Moderate, or High:

1. Effectiveness focuses on a) potential impacts to human health and the environment during the construction and implementation phase and b) reliability and proven history of the technology types or process options with respect to the detected hazardous substances and conditions at the Site .
2. Implementability is defined as the technical and institutional feasibility of implementing a technology type or process option.
3. Cost refers to relative capital, operations, and maintenance costs based on the engineer's opinion, within each Remedial Technology subset.

Process options are rated on a stand alone basis in this step of the FS process. When combined with other process options as part of a proposed remedial action alternative, the alternative may be ranked higher than each individual option.

Section 5
Development and Screening of Remedial Action Alternatives

In this section, remedial action alternatives are developed using combinations of technologies and process options that passed the screening in Section 4.2. These alternatives, in accordance with the guidance from the NCP, are then screened using the broad criteria of effectiveness, implementability, and cost. Alternatives that pass this broad criteria screening are evaluated in more detail in Section 7.0.

5.1 Description of Alternatives

Using the retained process options summarized in Section 4.3 of this FS, the following remedial action alternatives were developed for OU1 soils.

- Alternative 1 - No Action
- Alternative 2 -SVE/Partial Capping/ICs
- Alternative 3 - Hot Spot Excavation/SVE/Partial Capping /ICs
- Alternative 4 - Thermally-Enhanced SVE/Partial Capping/ICs

These alternatives have been formulated according to the NCP [40 CFR 300.430 (e)] and are intended to meet RAOs to various degrees. Each alternative is presented in the following paragraphs in sufficient detail to allow effective screening by broad criteria. Alternatives that are retained for detailed analysis are developed in more detail in Section 7.

5.1.1 Alternative 1 - No Action

This alternative is required by the NCP so that a baseline set of conditions can be established against which other remedial actions may be compared. This alternative allows the site to remain in its current state with no remedial actions being implemented.

5.1.2 Alternative 2 -SVE/Partial Capping/ICs

Alternative 2 would include installation of an SVE system within the OU1 area where soils exceed site-specific PRGs. For costing purposes, it is assumed that the SVE system would consist of approximately 18 wells throughout the vadose zone. Extracted vapors would be piped to one or more air blowers. Well details (depth, screened interval, and location) will be determined during the design process.

For purposes of this FS, it is assumed vapor-phase granular activated carbon (VGAC) would be used for vapor treatment, as the pilot test results have indicated VGAC is effective in treating the vapor phase site COCs.

Under the partial capping component of this remedy, the paved portions of the Phase 1a area would be maintained throughout the operation of the remedy.

ICs, such as restrictions limiting the disturbance of surface and shallow soils and preventing breeching of paved areas without proper exposure mitigation protection would be included under this alternative. To the extent reasonably practicable, these will be implemented either through land use covenants negotiated with the landowners, which will run with the land, through special building or other permit restrictions negotiated with and enacted by the municipal authority in this area or some combination of both. Where landowners and/or local municipalities who are PRPs are involved, EPA has the authority to require that such covenants or municipal restrictions be established under its CERCLA enforcement authority in the event that such negotiations are not successful. It is expected that appropriate ICs will remain in place until such time as EPA deems the remedy complete.

5.1.3 Alternative 3 - Hot Spot Excavation /SVE/Partial Capping/ICs

Under Alternative 3, the area with the most contaminated soils (greater than 10 mg/Kg PCE) above the 30-foot unit would be excavated. This trigger concentration was selected based on an evaluation of all soil data and represents a break point whereby the volume of soils above this level was a reasonable volume of soil for hot spot excavation.

All excavated material would be transported to an appropriate landfill for ex situ treatment and disposal. The ex situ treatment would likely consist of low temperature thermal desorption. Excavated areas would be replaced with clean fill material, contoured to control surface run on/runoff, and then covered with asphalt. Capping would be installed in unpaved areas of the Phase 1a area. Additional surface water run on/runoff controls such as drainage controls (water collection piping, ditches) would be included as part of this alternative, as required.

Alternative 3 would include installation of an SVE system within the OU1 area where soils exceed site-specific PRGs. For costing purposes, it is assumed that the SVE system would consist of approximately 18 wells throughout the vadose zone. As discussed previously, well details (depth, screened interval, and location) will be determined during the design process. Extracted vapors would be piped to one or more air blowers. As described for the SVE system in Alternative 2, VGAC would be used for vapor treatment.

Partial capping and ICs described for Alternative 2 are also included in Alternative 3.

5.1.4 Alternative 4 -Thermally-Enhanced/SVE /Partial Capping/ICs

Alternative 4 would include installation of a thermally-enhanced SVE system within the OU1 area where soils exceed site-specific PRGs. For costing purposes, it is assumed that electrical resistance heating would be used to thermally-enhance SVE. The system would consist of approximately 234 wells (some of which would be combination wells and electrodes) throughout the vadose zone piped to one or more air blowers. As discussed previously, well details (depth, screened interval, and location) will be determined during the design process. Extracted vapors would be drawn from the SVE wells into a condenser, then into a liquid/vapor separator, and finally through vapor phase GAC units for treatment. Condensate collected in the liquid/vapor separator would be transferred to the OU1 groundwater containment system for treatment prior to discharge.

Partial capping and ICs described for Alternative 2 are also included in Alternative 4.

5.2 Screening of Alternatives

The purpose of this screening evaluation is to reduce the number of alternatives that undergo a more thorough and extensive analysis in Section 7. Therefore, alternatives are evaluated more generally in this section than in the detailed analysis. Per the NCP guidance, each alternative is screened on effectiveness, implementability, and cost.

Effectiveness relates to the ability of the remedial alternative to satisfy five evaluation criteria:

- Overall protection of human health and the environment (meets RAOs)
- Compliance with ARARS
- Short-term effectiveness (during remedial construction) and immediately after implementation of the remedy
- Long-term effectiveness and permanence (following remedial construction)
- Reduction of toxicity, mobility, or volume through treatment

Effectiveness of each alternative is judged as follows:

- High: The alternative is effective in meeting all of the above criteria.
- Moderate: The alternative is effective in the overall protection of human health and the environment and compliance with ARARS, but one or more of the remaining three criteria are not met.
- Low: The alternative is less protective of human health and the environment.

The effectiveness evaluation is based on theoretical cleanup times determined from engineering experience and information gathered from the SVE pilot study.

Implementability relates to the technical and administrative feasibility of constructing, operating, and maintaining the alternative. Technical feasibility relates to the practical aspects of construction, operation, and maintenance. Administrative feasibility relates to the ability to obtain permits; procure treatment, storage, and disposal services; and procure the needed land, equipment, and expertise. Technologies have been previously screened in Section 4 and infeasible technologies eliminated. Implementability of the alternatives is therefore judged solely as follows:

- High: The alternative is readily implemented and relies on proven technologies. Administrative elements are standard to the jurisdictional agencies.
- Moderate: The alternative is implementable and relies largely on proven technologies. Use of less available or innovative technology or more study may be required. Some administrative elements are not standard to jurisdictional agencies.
- Low: The alternative relies on less available or innovative technology or more study may be required. There may be logistical limitations to implementing an alternative. In addition, many administrative elements are not standard to jurisdictional agencies.

The approximate present worth cost for each of the alternatives is estimated using relative costs rather than detailed estimates. At this state of the FS process, the cost analyses are subjectively made based on engineering judgment. Estimated operations and maintenance costs are assumed for each alternative based on the calculated time required for each alternative to achieve PRGs. The cost of each alternative is judged as follows:

- High: Over $9,000,000
- Moderate: Over $2,000,000 to $9,000,000
- Low: Under $2,000,000

The costs are refined in Section 7 for those alternatives that make it to the detailed evaluation.

A description of the evaluation of each alternative is presented in the following subsections.

5.2.1 Alternative 1 – No Action

Effectiveness

Low. This proposed alternative does not provide any reduction in contaminant concentrations or protection of human health and the environment. The no action alternative does not reduce contamination in groundwater and does not prevent potential exposure by eliminating potential exposure pathways for contaminated soils and soil gas. Therefore, this alternative does not meet ARARs.

Implementability

High. The proposed alternative requires no action and is therefore highly implementable.

Cost

Low. There are no costs associated with this alternative.

Screening Result

This proposed alternative is retained for further analysis as it provides a basis for comparison as required by the NCP.

5.2.2 Alternative 2 -SVE/Partial Capping/ICs

Effectiveness

High. Alternative 2 is effective in overall protection of human health by mitigating exposure to contaminated soils and potential exposure to soil gas. The SVE system would reduce contaminant concentrations in soil above 30 feet bgs to below the residential site-specific PRGs. Since the ICs component of this alternative would maintain the integrity of capped areas, Alternative 2 provides a long-term effective and permanent remedy. Use of appropriate personal protective equipment (PPE) and dust suppression measures throughout the remedy construction would provide an effective short-term solution to human exposure.

Implementability

Moderate. Implementation of the SVE system would be relatively straight forward and would use common construction techniques.

Cost

Moderate. Screening level costs derived from generic unit costs published in standard estimating documents such as ECHOS and RS Means are estimated to be $8,000,000 for this alternative.

Screening Results

Based on high effectiveness, moderate implementability, and moderate costs, Alternative 2 will be evaluated in more detail in the FS process.

5.2.3 Alternative 3 - Hot Spot Excavation /SVE / Partial Capping /ICs

Effectiveness

High. This alternative would remediate all soils exceeding the site-specific PRGs in a timely manner. Contaminated soils outside the hot spot excavation on the former Omega Chemical property with concentrations greater than the site-specific PRGs would be addressed by SVE. The excavation component of Alternative 3 would provide a reduction of toxicity, mobility, and volume of waste because there would be ex situ treatment of the excavated soils prior to disposal in an appropriate landfill; and there would be treatment of VOCs removed by the SVE system.

The combination of maintaining the paved areas of OU1 with PCE concentrations above PRGs and SVE treatment would be protective of both human health and the environment. Alternative 3 would also be compliant with ARARs. The maintained paving would be effective in overall protection of human health by mitigating exposure to contaminated soils and potential soil gas exposure. Since the ICs component of this alternative would maintain the integrity of the paved areas and require SSD installation if applicable, Alternative 3 provides a long-term effective and permanent remedy. The SVE system proposed under Alternative 3 would remove and treat contamination from shallow, medium, and deep areas of the source area, mitigating the exposure pathway from soils and soil gas while removing the main source of contaminant loading to shallow groundwater. The SVE system would reduce contaminant concentrations in soil above 30 feet bgs to below the residential site-specific PRGs. Use of appropriate PPE and dust suppression measures throughout installation of the SVE wells and the cap would provide an effective short term solution to human exposure.

Implementability

Moderate. While excavation utilizes proven technologies, excavation to address all of contaminated soil material to depths of approximately 15 feet would be difficult to implement due to ramp construction and shoring requirements. In addition, removal and replacement of paved areas could negatively impact the businesses located within the former Omega Chemical property. Therefore, implementation of Alternative 3 would require coordination with several tenants to complete. Alternative 3 uses known and available technologies for cap construction, well installation, and surface treatments. Standard administrative activities such as coordination with OU-1 tenants prior to well or cap installation are required.

Cost

Moderate. Screening level costs derived from generic unit costs published in standard estimating documents such as ECHOS and RS Means are estimated as $6,000,000.

Screening Results

Based on high effectiveness, moderate implementability, and moderate costs, Alternative 3 is retained for detailed analysis.

5.2.4 Alternative 4 –Thermally-Enhanced SVE/Partial Capping/ICs

Effectiveness

High. The thermally-enhanced SVE system proposed under Alternative 4 would remove and treat contamination from the vadose zone, eliminating the exposure pathway from soils and potential exposure to soil gas while removing the source of contaminant loading to shallow groundwater. Maintaining the paved areas throughout OU-1 would also minimize infiltration and provide control of surface water drainage. Therefore, Alternative 4 would be protective of overall human health and the environment. Alternative 4 would also comply with all ARARs. Installation of both the SVE wells/electrodes and surface treatment systems could be completed within 3 to 4 months, allowing for treatment to begin within five to six months after initiation of construction activities. Therefore, Alternative 4 provides a remedy that is effective in the short term. The vapor treatment component of Alternative 4 provides a reduction in toxicity, mobility, and volume of contamination. The SVE system would reduce contaminant concentrations in soil above 30 feet bgs to below the residential site-specific PRGs. By removing and treating the contaminants from the soil, Alternative 4 removes the sources of soil gas and groundwater contamination, and thereby provides a permanent and effective long-term remedy for OU-1 soils.

Implementability

Moderate. Alternative 4 uses known and available technologies for partial capping, well installation, and surface treatments. Implementability is lower for the large number of electrode/SVE well borings that would be required and would need to be piped via sub-grade piping. In addition, providing a source of the significant amount of electrical power, conveying that power to the subsurface, and protecting nearby buildings and sub-grade utilities decrease the implementability of this alternative. Standard administrative activities such as coordination with OU-1 tenants prior to capping and well installation are required.

Cost

High. Screening level costs derived from generic unit costs published in standard estimating documents such as ECHOS and RS Means are estimated as $12,000,000 for this alternative:

Screening Results

Based on high effectiveness, moderate implementability, and high costs, Alternative 4 is retained for detailed analysis.

5.2.5 Screening Results Summary

Following the screening steps presented above, the following alternatives have been retained for detailed analysis:

- Alternative 1 - No Action
- Alternative 2 –SVE/Partial Capping/ICs
- Alternative 3 – Hot Spot Excavation/SVE/Partial Capping/ICs
- Alternative 4 – Thermally-Enhanced SVE/Partial Capping/ICs

5.2.6 SVE System Optimization and Enhancements

This section presents a discussion of how the SVE systems for Alternatives 2 and 3 would be optimized as remediation advances to completion. Also, a description of SVE system enhancements is provided if system performance data suggest that the cleanup goals may not be met by optimized operation of the SVE system.

<u>SVE System Optimization</u>

The SVE pilot test results from the site indicate that a significant ROI can be achieved in the vadose zone and that a high flow rate per well can be achieved. In addition, the vacuum readings that were collected during pilot testing indicate that a relatively uniform vacuum field was established in the soils around each well tested. These findings together suggest that SVE will be able to meet RAOs and achieve the cleanup goals for the site.

As performance monitoring data (mass removal rates and soil vapor VOC concentrations) are collected they would be evaluated with regard to the likelihood of achieving the site cleanup goals in a timely manner. If the data indicate that there are one of more areas that have relatively high VOC concentrations, and/or that there are significant "dead zones" (volumes of soil where little soil vapor is flowing), then optimization measures would be implemented. These would include:

- altering the applied vacuum levels to appropriate SVE wells with the objective of modifying the soil vapor flow patterns to eliminate dead zones
- capping or adding passive injection wells to modify the vapor flow patterns and eliminate dead zones
- adding new SVE wells at locations where significant dead zones exist

These optimization methods are commonly used for SVE systems and are usually highly effective in addressing problem areas of the vadose zone. It is the intent of OPOG to employ these optimization steps only if evaluation of the performance monitoring data indicates that optimization measures are necessary.

<u>System Enhancements</u>

There are several methods that can be used to enhance the performance of SVE if it appears the cleanup goals may not be achieved in a timely manner. These would most likely include hot air injection and DPE.

As a contingency, cost estimates for two of the more likely enhancements (hot air injection and DPE) have been prepared and included in the cost spreadsheets in Appendix A.

SVE would be operated until asymptotic total VOC removal rates have been achieved at each extraction well. Periodic rebound testing would be performed to document increases in the VOC concentrations that occur after the system has been shut down for an extended period of time. The first rebound test would likely be performed when the total system mass removal rate becomes nearly steady (asymptotic).

If, after system optimization, the post-rebound VOC concentrations remain above the site-specific residential PRGs (as defined in the HHRA) for soil gas in the upper 30 feet, or above cleanup levels that protect groundwater in the lower 30 feet, then enhancements to the SVE system, potentially including hot air injection and/or DPE would be implemented. The enhancements would be implemented for the entire system or at a targeted area, but at a minimum at the wells that triggered the enhancement installation.

If VOC concentrations remain above the site-specific PRGs after initial enhancement is implemented, and data demonstrate that significant vapors are derived from volatilization from groundwater, then additional enhancements, potentially including DPE would be implemented.

If post-rebound VOC concentrations at a given well are below site-specific PRGs, then SVE from that well would be terminated and the well would be turned to a passive injection well (as appropriate) subject to capping and monitoring of vapor concentrations for VOCs during future rebound tests.

Changes in the system operation, such as the termination of SVE from a given well, timing and duration of rebound tests, turning of wells into passive injection wells, changes of flow rates and applied vacuum from design levels, and installation of SVE enhancements would be subject to EPA review and approval and implemented at EPA's discretion.

Section 6
Definitions of Criteria Used in the Detailed Analysis of Alternatives

In this section of the FS, the alternatives are developed in more detail and evaluated against seven criteria as outlined by the NCP. This evaluation includes a comparative analysis of the relative performance of each alternative to the same seven criteria. The evaluation criteria are discussed in Section 6.1, alternatives are further developed and evaluated in Section 7, and the comparative analysis is presented in Section 7.2.

6.1 Evaluation Criteria

The detailed evaluation applies seven evaluation criteria to each alternative listed above. These criteria are grouped into the following three categories: threshold criteria, primary balancing criteria, and modifying criteria. A discussion of each threshold and primary balancing criterion is presented in this section. The two modifying criteria (i.e., state acceptance and community acceptance), which reflect the support of the state and the community, are not evaluated at this stage of the FS process. These criteria will be considered after receipt of public comments on the proposed remedy for onsite soils.

6.1.1 Threshold Criteria

Two threshold criteria relate directly to the statutory compliance of the alternative in question: (1) overall protection of human health and the environment and (2) compliance with ARARs. A given alternative must meet these criteria to be considered as a remedy.

6.1.1.1 Overall Protection of Human Health and Environment

Under this criterion, the adequacy of the protection afforded by a remedial action must be addressed. The means by which risks will be eliminated, reduced, or controlled through treatment, engineering controls, or ICs must be described.

6.1.1.2 Compliance with ARARs

Under this criterion, the means by which a given remedial alternative would meet the ARARs identified in Section 2 must be established. Compliance with the chemical- and action-specific ARARs must be attained by the alternative to be considered as a remedy.

6.1.2 Primary Balancing Criteria

Five primary balancing criteria address the technical and cost criteria for each alternative: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, or volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost.

6.1.2.1 Long-Term Effectiveness and Permanence

Under this criterion, the effectiveness and permanence of the remedial action is established in terms of risk remaining at the site after the remedial action. The adequacy and reliability of ICs required with the alternative are evaluated to determine if appropriate risk management of the treatment residuals or untreated waste is in place.

6.1.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

Under this criterion, the degree and quantity of contaminant toxicity, mobility, and/or volume reduction by use of the specified treatment is evaluated. The anticipated performance of a treatment technology employed by remedial action in terms of long-term reliability of the treatment process and the type and quantity of treatment residuals is discussed.

6.1.2.3 Short-Term Effectiveness

Under this criterion, the impacts on the community, site workers, and the environment during the construction and implementation phase are evaluated. This phase lasts through the construction phase of the remedial action. The duration until protection is achieved is also considered. In addition to the impacts on human health, the potential adverse environmental impacts during the construction are evaluated.

6.1.2.4 Implementability

Under this criterion, the technical and administrative feasibility of implementing the alternative is evaluated. The availability of needed materials and services is also considered. The technical feasibility considerations include the technical difficulties anticipated in construction, reliability of the selected technology, and ease of implementing the remedy. Administrative feasibility considers coordination of interested parties, as well as any required permits.

6.1.2.5 Cost

Under this criterion, estimates are made of capital costs, engineering expenses, and the present worth of future O&M and periodic costs. Cost estimates are developed according to *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000a). While flexibility has been incorporated into each alternative for the location of remedial facilities, the selection of cleanup levels, and the period in which remedial action will be completed, the project scope and duration must be defined in order to provide a cost estimate. As a result, a number of assumptions must be made to provide cost estimates for the various remedial alternatives. Important assumptions specific to each alternative are summarized in the description of the alternative. Additional assumptions are included in the detailed cost estimates in Appendix A.

The cost estimate is expected to be within -30 to +50 percent of the actual cost. The costs are discussed with respect to the following items:

- Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs.

- O&M costs refer to post-construction cost items necessary to ensure the continued effectiveness of a remedial action and typically consist of long-term labor, power, and material costs.

- Periodic costs include items that are required intermittently at greater than 1-year intervals.

A present worth analysis has been used to normalize all capital, O&M, and periodic costs of a remedial alternative. In this analysis, all capital costs are assumed to be incurred within the first year of implementation. Future O&M and periodic costs are included and reduced by the appropriate future value/present worth discount factor of seven percent as outlined in the FS costing guidance.

6.2 Estimating Cleanup Times

There is often significant innate uncertainty in estimating subsurface remediation times due to uncertainties associated with the precise distribution of contaminants and the rates that the contaminants will respond to the applied treatments. However, for the purpose of evaluating remedial alternatives, it is necessary to make these estimates. This subsection describes the approach that has been taken to estimate remediation times for Alternatives 2, 3 and 4.

For the SVE components of all three alternatives, it has been assumed that the system would be operated until asymptotic total VOC removal rates and site-specific residential cleanup goals specified in the HHRA in the upper 30 feet and cleanup goals that protect groundwater in the lower 30 feet have been achieved. In achieving these removal rates, operation of the SVE system would reduce the potential for vapor migration beyond capped areas in all three alternatives. Rebound testing would then be performed to document the extent of VOC concentration rebound that occurs after the system has been shut down for an extended period of time. If rebound testing results indicate no significant VOC mass would be removed by continued SVE operation, then the system will be turned off, subject to periodic monitoring of vapor concentrations.

The SVE systems would reduce contaminant concentrations in soil above 30 feet bgs to below the residential site-specific PRGs. For the purpose of estimating costs, it has been assumed for Alternatives 2 and 3 that SVE would operate for five years and that rebound testing would occur for six months thereafter.

To estimate the remediation time for Alternative 4, we have relied on the experience of Thermal Remediation Services (a major thermal remediation vendor). It is assumed that thermal-enhanced SVE would reach asymptotic conditions and soil concentrations below the site-specific PRGs in one year. An additional six months are assumed to verify remediation via rebound testing for a total remediation time of 1.5 years.

Lastly, it has been assumed that the soil VOC concentrations following SVE operations for all three alternatives would meet the third RAO and be protective of groundwater quality. This is based not only on the known ability of SVE to reduce soil VOC concentrations to low levels, but also because all three alternatives include capping of unpaved areas within the PCE site-specific PRG for PCE (Figure 7-2). The capping component would significantly reduce the amount of water that infiltrates through the vadose zone to the underlying groundwater, further adding to the protection of groundwater.

Section 7
Detailed Analysis of Alternatives

In this section, the remedial alternatives that passed the general screening process in Section 5 are analyzed in detail. The purpose of this analysis is to present the relevant information that decision makers need to select a site remedy. Four alternatives are considered:

- Alternative 1 - No Action
- Alternative 2 - SVE/Partial Capping/ICs
- Alternative 3 - Hot Spot Excavation /SVE/Partial Capping/ICs
- Alternative 4 - Thermally-Enhanced SVE/Partial Capping/ICs

These alternatives are developed in more detail and evaluated against seven criteria. A comparative analysis is then performed to evaluate the relative performance of each alternative to the same seven criteria. The evaluation criteria were discussed in Section 6, alternatives are further developed and evaluated in Section 7.1, and the comparative analysis is presented in Section 7.2

7.1 Development of Alternatives

The detailed descriptions of alternatives in this section are used as the basis for the detailed cost estimates. The final details of each alternative may be revised during the remedial design phase.

7.1.1 Alternative 1: No Action

This alternative is required by the NCP so that a baseline set of conditions can be established against which other remedial actions may be compared. This alternative allows the site to remain in its current state with no remedial actions being implemented.

7.1.2 Alternative 2: SVE/Partial Capping/ICs

Paved portions of the Phase 1a area would be maintained throughout operation of the remedy. Figure 7-1 illustrates the hot spot excavation location, and Figure 7-2 illustrates the conceptual layout for Alternatives 2 and 3. Figure 7-3 provides additional information regarding the ground surface (e.g., bare soil or grass, asphalt or concrete paving, visible condition, etc.) within these contour lines.

The SVE system in Alternative 2 would address those soils that exceed the site-specific PRGs. For shallow soils (here defined as those above the 30-foot unit), the area of these exceedances falls with the two contour lines: the site-specific PRG for PCE in soil (3.9 mg/kg), and the CHHSL for PCE in soil gas (0.603 mg/m^3). These two contour lines are shown on Figure 7-2.

For soils deeper than the 30-foot layer, because of the prevalence of PCE in site soils, the area of site-specific PRG exceedances falls within the site-specific soil PRG for PCE. This contour line for deep soils is shown in Figure 7-4.

To remediate these soils, Alternative 2 incorporates a SVE system that consists of approximately 18 wells. Two shallow existing SVE wells, installed to a depth of 25 feet bgs and screened from 10 to 25 feet bgs, which were used in the pilot test would be upgraded and used as part of the SVE system. Ten additional shallow SVE wells would be installed to 25 feet bgs and screened in the same interval. Locations of both the existing and new shallow wells are shown in Figure 7-2. Six deep SVE wells would be installed to approximately 65 feet bgs and screened from 45 to 60 feet bgs (Figure 7-4). Three deep vapor monitoring points would be installed to verify the ROI of the SVE system. As discussed previously, well details are subject to change as design proceeds.

Piping from each of these 18 SVE wells would be run to a common sub-grade manifold, then to the intake of two 1,200 scfm rotary claw blowers operated in parallel. Each blower would be capable of producing approximately 15 inches of mercury vacuum at each wellhead.

Approximately 125 scfm of extracted vapors would be drawn from each SVE well (a total of 2,250 scfm) and into a liquid/vapor separator. Vapors from the separator would pass through vapor-phase granular activated carbon (VGAC) units for treatment prior to atmospheric discharge. Condensate collected in the separator would be transferred to the OU1 non-time-critical removal action (NTCRA) groundwater containment system for treatment prior to discharge

The pilot test data indicate a relatively high vacuum needs to be applied to the SVE wells to achieve the conceptual design ROI. The application of high vacuum in the vicinity of the water table can cause the water table to rise, saturating the deepest part of the vadose zone thereby making it unavailable for remediation by SVE. Therefore, the system design will include elements to minimize this effect. These likely will include making the total depth of deep SVE wells significantly above the water table elevation; and leaving vadose zone monitoring points that are screened in the deep vadose zone uncapped so they act as vents that allow air to enter the deep zone and relieve some of the vacuum near the water table. In addition, it is anticipated that as the SVE system reaches asymptotic levels of VOC mass removal, that the wells will be operated in various combinations (some wells will be turned off) to allow the water table to decline in some areas and to modify the air flow pathways during extraction.

It is anticipated that the SVE system will be able to achieve both industrial and residential site-specific PRGs for all volatile COCs. However, if, after the system has been optimized, system performance monitoring suggests that this may not be the case, then system enhancements will be evaluated. The cost spreadsheets in Appendix A include estimated costs for applying two of these enhancements: hot air injection and DPE. The costs associated with implementing hot air injection have been added to Alternatives 2 and 3 as a contingency.

After VOC mass removal rates have reached asymptotic levels and rebound testing has been performed, then confirmation soil and soil vapor samples will be collected to verify that cleanup goals have been attained. Such sampling is also implicitly included in the SVE components of Alternatives 3 and 4.

An indoor air monitoring program would be implemented as part of this alternative. Upon startup of the SVE system, indoor air samples would be collected in each of the buildings on or adjacent to the site. These buildings will also be included in subsequent annual indoor air sampling. During the 5-year reviews the list of buildings for annual indoor air sampling will be evaluated and modified as needed. An indoor air sampling work plan would be prepared that would describe the sampling and analysis methods to be used for the initial and annual sampling. Annual reports would be prepared that would present the sample results and an evaluation of the results with regard to the need for mitigation measures. Should indoor air concentrations exceed risk based levels, subsequent installation of appropriate mitigation measures (e.g., SSD) in existing buildings would be required.

ICs such as building restrictions preventing breeching of paved areas without proper exposure mitigation protection and replacement of the cap material would be included under this alternative. ICs such as restrictions for construction requiring excavation below 15 feet in the hot spot area without exposure mitigation protection for workers would also be included in Alternative 2.

7.1.3 Alternative 3: Hot Spot Excavation/ SVE /Partial Capping/ICs

Alternative 3 includes the same SVE system as described above for Alternative 2. As in Alternative 2, paved areas of the Phase 1a area would be maintained to minimize both surface exposure and groundwater infiltration under Alternative 3.

Figure 7-4 illustrates the conceptual layout for deep SVE wells for Alternative 3. Under Alternative 3, hot spot excavation would be conducted in an approximately 5,000 square foot area west and south of Star City Auto Body on the former Omega Property (Figure 7-1). Contaminated soils exceeding approximately ten milligrams per kilogram (mg/Kg) PCE would be excavated to a maximum depth of 15 feet bgs. This concentration, derived from an evaluation of site soil data, addresses the highest levels of PCE and other COCs in soils onsite. This excavation would include removal and replacement of all existing pavement within this area. All excavated material would be transported to an appropriate landfill for ex situ treatment and subsequent disposal. Excavated areas would be replaced with clean fill material, contoured to control surface run on/runoff, and then covered with asphalt. Existing pavement within this area would be demolished and transported to an offsite disposal area prior to excavation. Contaminated soils would be excavated using a track hoe type excavator, temporarily stockpiled on a geotextile covered area onsite, and then transported for ex situ treatment and disposal. A geotextile marker would be placed at the base of the excavation. Clean fill material, transported from offsite, would be placed in the excavated area, contoured to control surface run on/runoff, then covered with a low permeability asphalt cover.

ICs such as building restrictions preventing breeching of paved areas without proper exposure mitigation protection and maintenance of the paved areas would be included under this alternative. In addition, ICs would also include the indoor air monitoring program described for Alternative 2. Should indoor air concentrations exceed risk based levels, subsequent installation of appropriate mitigation measures (e.g., SSD) in existing buildings would be required. ICs such as restrictions for construction requiring excavation below 30 feet in the hot spot area without exposure mitigation protection for workers would also be included in Alternative 3.

7.1.4 Alternative 4: Thermally-Enhanced SVE/Partial Capping/ICs

As for Alternatives 2 and 3, paved areas of the Phase 1a area would be maintained to minimize both surface exposure and groundwater infiltration under Alternative 4.

Under Alternative 4, SVE would be enhanced by an electrical resistance heating system (ERH). The SVE system of this alternative would address the same volume of soils described for Alternatives 2 and 3. The thermally-enhanced SVE system would consist of approximately 234 wells installed to 75 feet bgs and screened from 4 to 75 feet bgs, depending on location (Figure 7-5). As discussed previously, well details are subject to change as design proceeds. Electrodes would be installed in approximately 220 of these wells to a depth of 75 feet bgs. Piping from each of these 234 wells would be run to common sub-grade manifolds, then to the intake of two rotary claw blowers operated in parallel. Each blower would be capable of producing approximately 15 inches of mercury vacuum at each wellhead.

Approximately 2,800 scfm of total extracted vapors would be drawn from the enhanced SVE well systems and into a steam condenser, then into a liquid/vapor separator prior to treatment. Vapor from the separator would pass through VGAC units for treatment prior to atmospheric discharge. Condensate collected in the separator would be transferred to the NTCRA OU1 groundwater containment system for treatment prior to discharge.

ICs such as building restrictions preventing breeching of paved areas without proper exposure mitigation protection and maintenance of paved areas would be included under this alternative. In addition, ICs would also include the indoor air monitoring program described for Alternative 2. Should indoor air concentrations exceed risk based levels, subsequent installation of appropriate mitigation measures (e.g., SSD) in existing buildings would be required.

7.2 Comparative Analysis

This section compares the alternatives (other than Alternative 1) to one another against the seven criteria.

7.2.1 Overall Protection of Human Health and the Environment

Of the three non-no action alternatives, Alternative 4 would achieve cleanup goals approximately 4 years faster than Alternatives 2 or 3. For all three alternatives, ICs would provide restrictions on activities that may increase exposures to contaminated soils or soil vapor.

7.2.2 Compliance with ARARs

Alternative 1 does not meet ARARs. Alternatives 2, 3 and 4 would relatively quickly reduce VOC concentrations in soils and soil vapors to levels that meet ARARs. Therefore, these alternatives are compliant with chemical-specific ARARs. The design and construction of the selected remedial alternative will address the action-specific ARARs identified in Table 3-1.

7.2.3 Short-Term Effectiveness

Alternatives 2, 3 and 4 would be effective in the short term as they all would begin reducing COC soil concentrations upon startup. There would be some short-term risks associated with the hot spot soil excavation and ex situ treatment for Alternative 3. Similarly, there would be some short-term risks above those for Alternative 2 associated with Alternative 4 related to setting up the electrical supply system that would be needed to elevate the subsurface temperature.

Alternatives 3 and 4 would require a construction and startup effort of approximately four-month duration. Alternative 2 would require approximately 3 months for construction and startup. The time estimated to initially reduce the concentrations of VOC contamination to concentrations required by ARARs using Alternatives 2 and 3 is 5.5 years. With SVE and vapor treatment immediate reductions are expected in VOC concentrations in soils. Therefore, these alternatives are highly effective in the short term. Alternatives 3 and 4 require a larger construction effort and timeframe compared to Alternatives 2. This is due to the need to install the thermal electrodes, generate the required amount of electricity, and convey it to the electrodes for Alternative 4 and the need to perform the hot spot excavation for Alternative 3.

The time estimated to initially remediate the soils to cleanup levels using Alternative 4 is approximately 1.5 years. After initial remediation, soil vapors contained in residual contamination NAPL may "rebound" to levels that would require pulsed operation of the SVE system. Therefore, this alternative is also effective for soils cleanup in the short term. With thermally-enhanced SVE, immediate reductions are expected in COC concentrations in soil.

For all three alternatives fugitive dust emissions from the construction of the remediation building and trenching activities and from the excavation could potentially impact workers and the environment during implementation and would, therefore, be controlled and monitored during construction. Due to the excavation component, Alternative 3 would produce the greatest amount of fugitive dust emissions.

7.2.4 Long-Term Effectiveness and Permanence

Based on experience at similar sites, Alternatives 2 and 3 will require an estimated 5.5 years to initially remediate the contaminated soils to cleanup levels and Alternative 4 will require approximately 1.5 years. Under Alternatives 2 and 3, after initial remediation, soil vapors contained in residual saturation may "rebound" to levels that would require pulsed operation of the SVE system. If these alternatives are implemented and maintained for their life expectancy, they would be highly effective in the long-term.

7.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Because each of the three non-no action alternatives has a SVE system that incorporates vapor treatment, each meets this criterion. Contaminants would be permanently removed from the site via the vapor treatment process. Alternative 3 would also remove contaminants from the site via excavation, offsite ex situ treatment and offsite disposal.

7.2.6 Implementability

The SVE aspects of all three alternatives can be readily implemented with available and proven technologies. Construction and O&M of SVE systems have been implemented at many sites and utilize well-proven technologies. The systems may require periodic replacement of pumps, piping, and vessels comprising both the SVE systems and the vapor treatment systems. Installation of some of the SVE wells and piping will require access agreements from surrounding property owners. Table 7-1 provides estimates for the durations of various aspects of implementing Alternatives 2, 3 and 4.

Compared with Alternatives 2 and 3, Alternative 4 would involve several implementation issues. Providing the significant amount of energy needed to heat the subsurface and getting this energy safely to the electrodes would be significantly more difficult compared to traditional SVE construction and operation. In addition, the system would need to be protective of nearby buildings and sub-grade utilities. This alternative would require significantly more boreholes for electrodes and SVE wells, and these would need to be properly abandoned following remediation.

Alternative 3 would rate lower than Alternative 2 for implementability due to the need to shore during excavation and the need to protect nearby buildings. Worker protection would also be an issue during excavation due to the high soil concentrations that would likely be encountered. Provisions would need to be made to protect against VOCs migrating from the excavation to neighboring properties.

7.2.7 Cost

A summary of the costs for all alternatives is shown in Table 7-2. Summary tables for Alternatives 2, 3, and 4 and detailed cost breakdowns for items in Table 7-2 are provided in a series of cost worksheet tables in Appendix A (Table A-4). The present worth costs for the non-no action alternatives ranged from $6.5 million (Alternative 2) to $16.0 million (Alternative 4). Alternative 3 is estimated to have a present worth cost of $9.5 million. Cost estimates have also been made for two SVE enhancements - hot air injection and DPE. The estimated costs for hot air injection ($450,000 capital and $32,300 annual) have been added to Alternatives 2 and 3 costs as contingencies, and are included in the costs shown on Table 7-2. The estimated cost for the contingency of DPE ($1,100,000 capital and $450,000 annual) is not included in the costs shown on Table 7-2

7.3 Summary of Comparative Analysis

A summary of the comparative analysis of alternatives, which highlights differences among alternatives in meeting the seven criteria, is presented in Table 7-3. This table shows that Alternative 2 (SVE/Partial Capping/ICs) ranked the highest of the four alternatives analyzed using the seven criteria.

Alternative 3 (Hot Spot Excavation/SVE/Partial Capping/ICs) ranked lower than Alternative 2 due the short-term risks associated with hot spot excavation. Alternative 3 was also more costly due the expense of excavating the hot spot soils and the subsequent transportation, treatment and disposal of excavated soils at a Class I landfill.

Alternative 4 (Thermally-Enhanced SVE/Partial Capping/ICs) remediated the soils faster compared to Alternative 2 (1.5 years compared to 5.5 years); however, there was considerable cost associated with the time savings ($16.0 million compared to $6.5 million). In addition, there are significant implementation issues associated with Alternatives 3 and 4 which added to a lower ranking compared to Alternative 2.

Legend
- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Hot Spot Excavation Location
- Existing Soil Vapor Extraction Well
- Existing Vapor Monitoring Probe Below the 30 Foot Unit
- Existing Vapor Monitoring Probe In the 30 Foot Unit

N

0 25 50 100
Feet

CDM

Omega Chemical
Hot Spot Excavation Location for Alternative 3

Figure 7-1

Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Shallow SVE Well Location
- Existing Soil Vapor Extraction Well
- Existing Vapor Monitoring Probe Below the 30 Foot Unit
- Existing Vapor Monitoring Probe In the 30 Foot Unit
- 75-foot Radius of Influence (ROI)

Shallow Soil Gas PCE (mg/m^3)

- Industrial / Commercial CHHSL (0.603 mg/m^3)

Soil PCE (mg/kg)

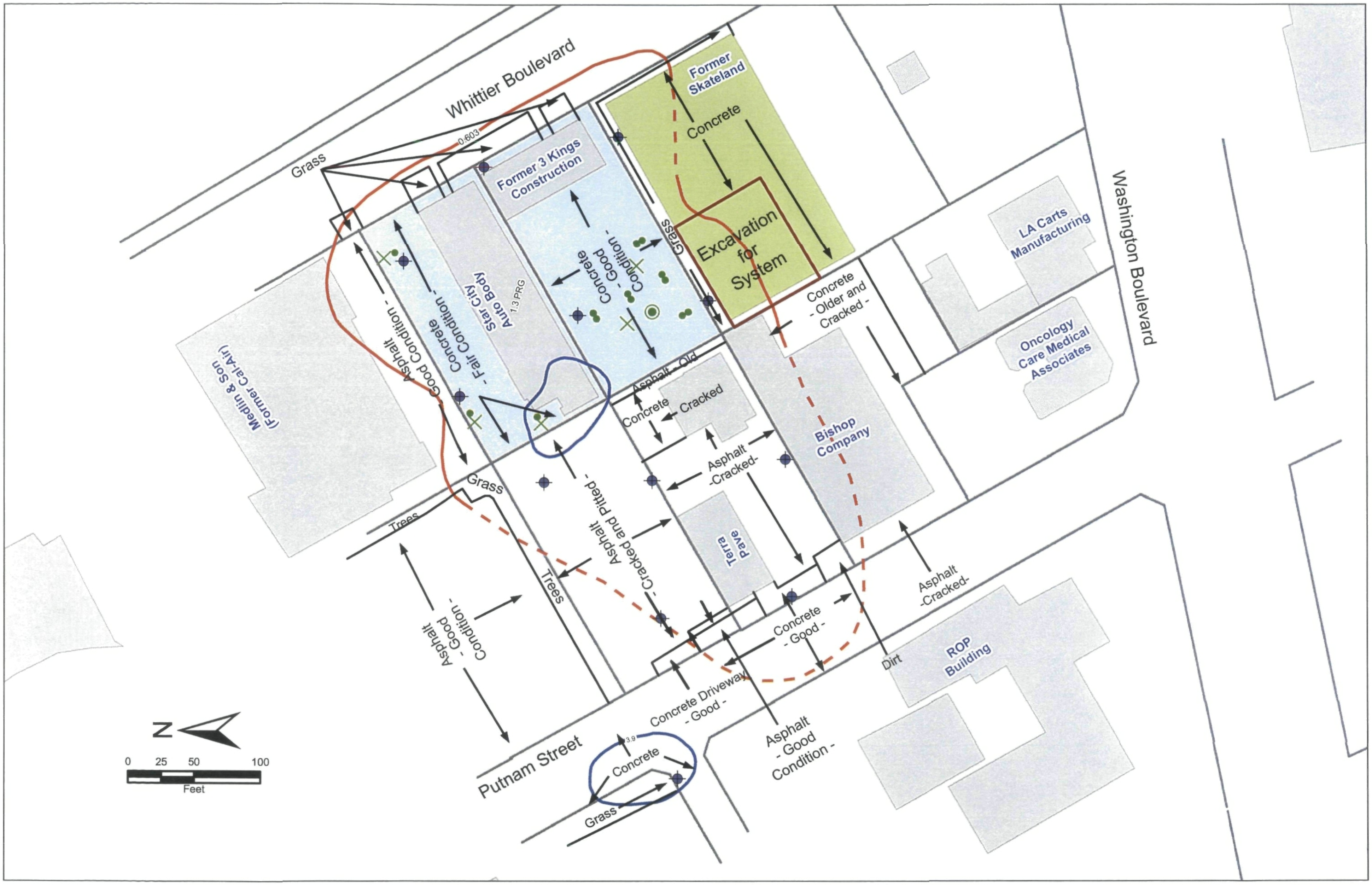
- Industrial / Commercial Site-Specific PRG (3.9 mg/kg)

CDM

Omega Chemical

Conceptual Layout of Shallow SVE Wells for Alternatives 2 and 3

Figure 7-2



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Shallow SVE Well Location
- Existing Soil Vapor Extraction Well
- Existing Vapor Monitoring Probe Below the 30 Foot Unit
- Existing Vapor Monitoring Probe In the 30 Foot Unit

Shallow Soil Gas PCE (mg/m^3)

- Industrial / Commercial CHHSL (0.603 mg/m^3)

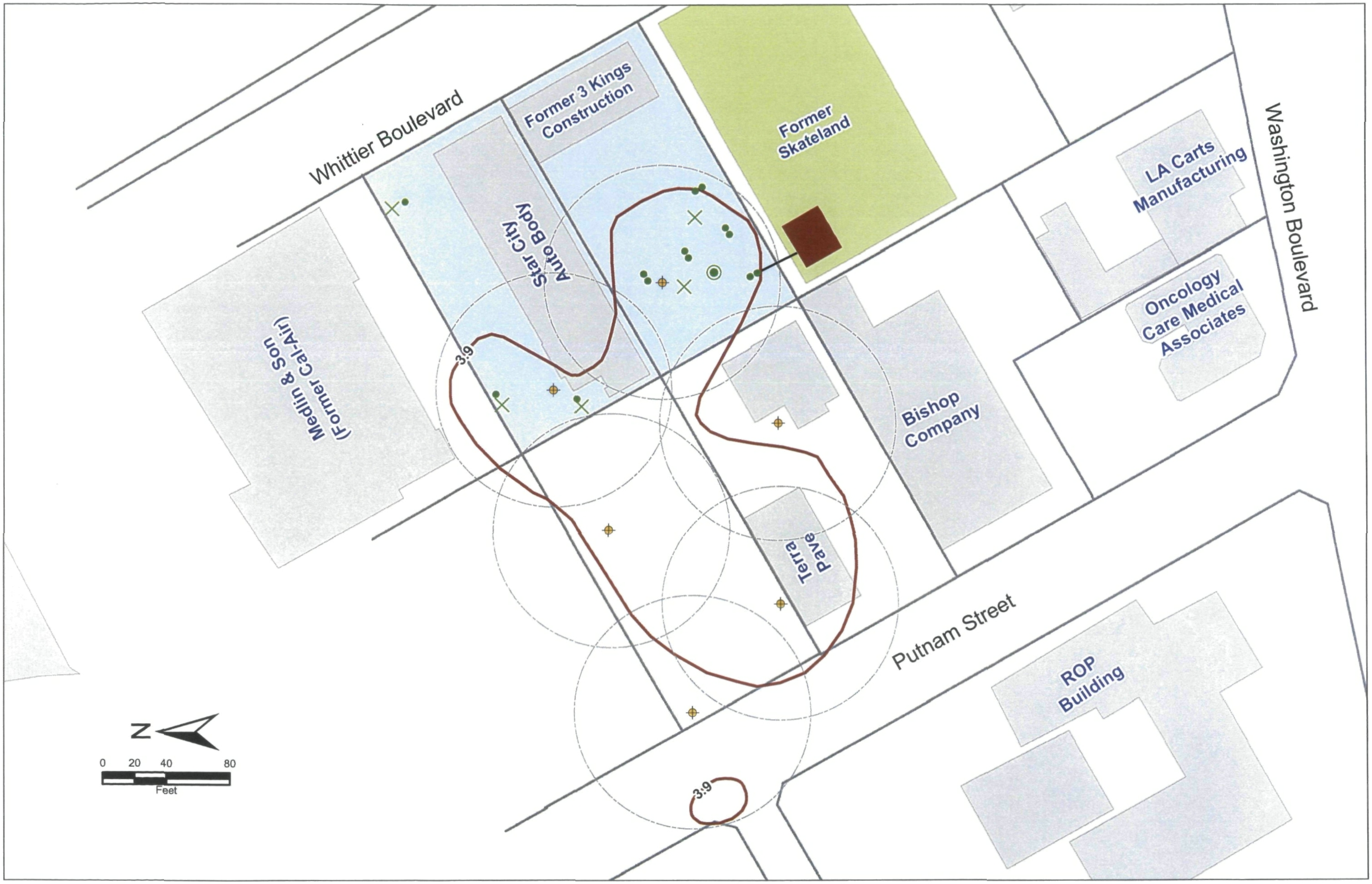
Soil PCE (mg/kg)

- Industrial / Commercial Site-Specific PRG (3.9 mg/kg)

CDM

Omega Chemical
Surface Type and Condition

Figure 7-3



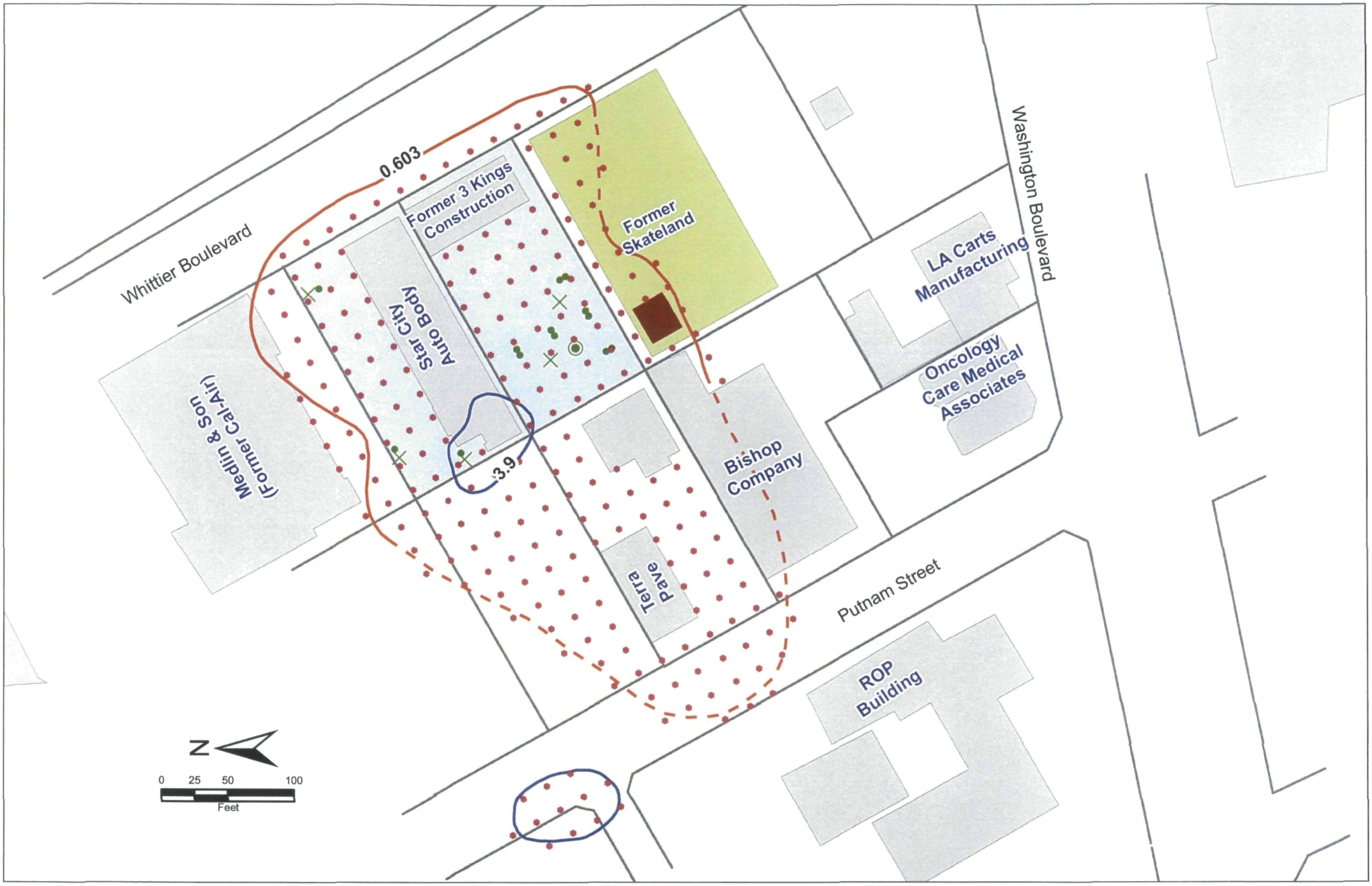
Legend
- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- 75-foot Radius of Influence (ROI)
- Proposed Treatment Facility
- Soil Vapor Extraction Piping - Alternative 3a
- Deep SVE Well Location
- Existing Soil Vapor Extraction Well
- Existing Vapor Monitoring Probe Below the 30 Foot Unit
- Existing Vapor Monitoring Probe In the 30 Foot Unit

PCE (mg/kg)
- Site-Specific Soil PRG (3.9 mg/kg)

CDM

Omega Chemical
Conceptual Layout of Deep SVE Wells for Alternatives 2 and 3

Figure 7-4



Legend

- Property Boundary
- Former Omega Chemical Property
- Existing Building
- Former Building
- Proposed Treatment Facility
- Proposed Borehole Locations for Electrodes/SVE Wells
- Existing Soil Vapor Extraction Well
- Existing Vapor Monitoring Probe Below the 30 Foot Unit
- Existing Vapor Monitoring Probe In the 30 Foot Unit

Shallow Soil Gas PCE (mg/m^3)

- Industrial / Commercial CHHSL (0.603 mg/m^3)

Soil PCE (mg/kg)

- Industrial / Commercial Site-Specific PRG (3.9 mg/kg)

CDM

Omega Chemical

Conceptual Layout of Thermally Enhanced SVE for Alternative 4

Figure 7-5

Table 7-1. Estimated Durations for Implementing Alternatives 2, 3 and 4.

Alternative	Design/Permitting	Construction/Startup	O&M	Testing to Support SVE Shutdown [1]	Closure Activities [2]	Total
	Duration in Years					
2	0.75	0.25	5	0.5	0.5	7
3	0.75	0.33	5	0.5	0.5	7.08
4	0.75	0.33	1	0.5	0.5	3.08

1. Includes rebound testing
2. Includes well abandonment

Table 7-2

COST ESTIMATE SUMMARY

Site:	Omega Chemical
Location:	Whittier, California
Phase:	FS (+30/-50%)
Base Year:	2007
Date:	May 07,08

	CAPITAL COST	ANNUAL COSTS YEAR 1	ANNUAL COSTS YEAR 2-5	PERIODIC COSTS	PRESENT WORTH COSTS
Alternative 1	NA	NA	NA	NA	NA
Alternative 2	$2,817,000	$1,025,900	$859,000	$13,800	$6,500,000
Alternative 3	$5,776,500	$1,025,900	$859,000	$13,800	$9,460,000
Alternative 4	$9,447,600	$6,970,800	NA	$13,800	$15,960,000

Table 7-3
Remedial Alternatives Comparative Analysis Matrix - Omega Chemical

Alternative	Description	Protection of Human Health and Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility or Volume Through Treatment	Short-term Effectiveness	Implementability	Cost Ranking (based on present worth)
1	No Further Action	Low	Low	Low	Low	Low	High	High
2	SVE/Capping/ICs	High	High	Moderate	High	Moderate	High	Moderate
3	Hot Spot Excavation/SVE/Capping/ICs	High	High	Moderate	High	Moderate	Moderate	Moderate
4	Thermally-Enhanced SVE/Capping/ICs	High	High	High	High	High	Moderate	Low

Section 8
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Appendix A
Cost Estimates

Table A-1

COST ESTIMATE SUMMARY

Alternative 2 - Partal capping/SVE/Ics

Site: Omega Chemical
Location: Whittier, California
Phase: FS (+30/-50%)
Base Year: 2008
Date: May 7, 2008

Description: This alternative would involve installation of SVE system that would consist of 12 shallow (2 of which are existing wells) and 6 deep wells. Installation of 12 shallow and 10 deep VMP wells. No installation of shallow VMP required for this alternative (use existing wells). Installation of 3 deep VMP. SVE system would remove approximately 2250 scfm (125 scfm/well). SVE wells would be piped to the blower. Extracted vapor would pass through air/water separator and than through VGAC prior to discharge into the atmosphere. Period of performance for this alternative assumed to be 5 years

CAPITAL COSTS

Description		Cost Backup Reference	Qty	Unit	Unit Cost	Total Cost	Comments
Contractor Work Plans		CW-1	1	LS	$61,000	$61,000	Standard RA documents, including storm water management
Mobilization/Demobilization of Equipment		CW-9	1	LS	$88,300	$88,300	
Permitting		CW-8	1	LS	$62,000	$62,000	
OU1 SVE:							
	Shallow SVE Well Installation	CW-3	10	Each	$9,900	$99,000	
	Existing SVE wells upgrade	CW-3	2	EA	$2,900	$5,800	
	Deep SVE Well Installation	CW-3	6	Each	$15,700	$94,200	
	SVE System (includes air/water separator, blower, heater, VGAC unit, all instrumentstion and controls, and treatment building)	CW-6	1	Each	$694,000	$694,000	
	Piping	CW-7	1	LS	$277,900	$277,900	
	Deep VMP Installation	CW-4	3	Each	$5,800	$17,400	
Institutional Controls Package		CW-12	1	LS	$28,100	$28,100	
Hot Air Injection		CW-14	1	LS	$450,000	$450,000	
					SUBTOTAL	$1,878,000	
	Contingency (scope and bid)		20%			$375,600	
					SUBTOTAL	$2,253,600	
	Project Management		10%			$225,400	
	Technical Support		15%			$338,000	
					TOTAL CAPITAL COST	**$2,817,000**	

ANNUAL COSTS - Year 1

All annual costs include GAC replacement

Description		Reference*	Qty	Unit	Unit Cost	Total Cost	Comments
O&M Costs 0-1		CW-10	1	LS	$651,600	$651,600	
Hot air injection O&M		CW-14	1	LS	$32,300	$32,300	
					SUBTOTAL	$683,900	
	Contingency (scope and bid)		20%			$136,800	
					SUBTOTAL	$820,700	
	Construction Management		10%			$82,100	
	Engineering		15%			$123,100	
					TOTAL O&M COST 0 -1	**$1,025,900**	

ANNUAL COSTS - Years 2 Thru 5

Description		Cost Backup Reference*	Qty	Unit	Unit Cost	Total Cost	Comments
O&M Costs 2-5		CW-10	1	Years	$540,400	$540,400	
Hot air injection O&M		CW-14	1	LS	$32,300	$32,300	
					SUBTOTAL	$572,700	
	Contingency (scope and bid)		20%			$114,500	
					SUBTOTAL	$687,200	
	Construction Management		10%			$68,700	
	Engineering		15%			$103,100	
					TOTAL O&M COST years 2-5	**$859,000**	

PERIODIC COST - Year 5

Description		Cost Backup Reference	Qty	Unit	Unit Cost	Total Cost	Comments
Institutional Controls Package Updates		CW-12	1	LS	$9,200	$9,200	
					SUBTOTAL	$9,200	
	Contingency (scope and bid)		20%			$1,800	
					SUBTOTAL	$11,000	
	Project Management		10%			$1,100	
	Technical Support		15%			$1,700	
					TOTAL PERIODIC COSTS	**$13,800**	

PRESENT VALUE ANALYSIS

COST TYPE	YEAR(S)	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)**	PRESENT VALUE	Comments
Capital Costs	0	$2,817,000	1	$2,817,000	
Annual Costs	1	$1,025,900	0.935	$958,800	
	2- 5	$859,000	3.166	$2,719,300	
Periodic Costs	5	$13,800	0.713	$9,839	
		TOTAL PRESENT VALUE OF ALTERNATIVE 2		**$6,500,000**	

*All cost backup reference sheets are presented in Appendix A of the Omega FS

** 7 % discount factors, based on OMB guidance, are taken from "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study"

DPE Contingency Capital Cost	$1,074,800
DPE Contingency O&M Cost	$449,800

Table A-2

Alternative 3 - Hot spot excavation/hSVE/Partial capping/IC

COST ESTIMATE SUMMARY

Site: Omega Chemical
Location: Whittier, California
Phase: FS (+30/-50%)
Base Year 2008
Date: May 7, 2008

Description:
This alternative would involve hot spot excavation of the area that encompass approximately 5,000 sf west and south of Star Auto Body on the former Omega property, installation of SVE system that would consist of 12 shallow (2 of which are existing wells) and 6 deep wells. Installation of 12 shallow and 10 deep VMP wells. No installation of shallow VMP required for this alternative (use existing wells). Installation of 3 deep VMP. SVE system would remove approximately 2250 scfm (125 scfm/well) SVE wells would be piped to the blower. Extracted vapor would pass through air/water separator and than through VGAC prior to discharge into the atmosphere. Period of performance for this alternative assumed to be 5 years

CAPITAL COSTS

Description	Cost Backup Reference	Qty	Unit	Unit Cost	Total Cost	Comments
Contractor Work Plans	CW-1	1	LS	$67,000	$67,000	Standard RA documents, including storm water management
Mobilization/Demobilization of Equipment	CW-9	1	LS	$88,300	$88,300	
Permitting	CW-8	1	LS	$62,000	$62,000	
Hot spot excavation	CS-2	1	LS	$1,967,400	$1,967,400	
OU1 SVE:						
Shallow SVE Well Installation	CW-3	10	Each	$9,900	$99,000	
Existing SVE wells upgrade	CW-3	2	EA	$2,900	$5,800	
Deep SVE Well Installation	CW-3	6	Each	$15,700	$94,200	
SVE System (includes air/water separator, blower, heater, VGAC unit, all instrumentstion and controls, and treatment building)	CW-6	1	Each	$694,000	$694,000	
Piping	CW-7	1	LS	$277,900	$277,900	
Deep VMP Installation	CW-4	3	Each	$5,800	$17,400	
Institutional Controls Package	CW-12	1	LS	$28,100	$28,100	
Hot Air Injection	CW-14	1	LS	$450,000	$450,000	
				SUBTOTAL	$3,851,000	
Contingency (scope and bid)		20%			$770,200	
				SUBTOTAL	$4,621,200	
Project Management		10%			$462,120	
Technical Support		15%			$693,180	
				TOTAL CAPITAL COST	**$5,776,500**	

ANNUAL COSTS - Year 1
All annual costs include GAC replacement

Description	*Reference**	*Qty*	*Unit*	*Unit Cost*	*Total Cost*	*Comments*
O&M Costs 0-1	CW-10	1	LS	$651,600	$651,600	
Hot air injection O&M	CW-14	1	LS	$32,300	$32,300	
				SUBTOTAL	$683,900	
Contingency (scope and bid)		20%			$136,800	
				SUBTOTAL	$820,700	
Construction Management		10%			$82,100	
Engineering		15%			$123,100	
				TOTAL O&M COST 0 -1	**$1,025,900**	

ANNUAL COSTS - Years 2 Thru 5

Description	Cost Backup Reference*	Qty	Unit	Unit Cost	Total Cost	Comments
O&M Costs 2-5	CW-10	1	Years	$540,400	$540,400	
Hot air injection O&M	CW-14	1	LS	$32,300	$32,300	
				SUBTOTAL	$572,700	
Contingency (scope and bid)		20%			$114,500	
				SUBTOTAL	$687,200	
Construction Management		10%			$68,700	
Engineering		15%			$103,100	
				TOTAL O&M COST years 2-5	**$859,000**	

PERIODIC COSTS - Year 5

Description	Cost Backup Reference	Qty	Unit	Unit Cost	Total Cost	Comments
Institutional Controls Package Updates	CW-12	1	LS	$9,200	$9,200	
				SUBTOTAL	$9,200	
Contingency (scope and bid)		20%			$1,800	
				SUBTOTAL	$11,000	
Project Management		10%			$1,100	
Technical Support		15%			$1,700	
				TOTAL PERIODIC COSTS	**$13,800**	

PRESENT VALUE ANALYSIS

COST TYPE	YEAR(S)	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)**	PRESENT VALUE	Comments
Capital Costs	0	$5,776,500	1	$5,776,500	
Annual Costs	1	$1,025,900	0.935	$958,800	
	2- 5	$859,000	3.166	$2,719,300	
Periodic Costs	5	$13,800	0.713	$9,839	
		TOTAL PRESENT VALUE OF ALTERNATIVE 3		**$9,460,000**	

*All cost backup reference sheets are presented in Appendix A of the Omega FS
** 7 % discount factors, based on OMB guidance, are taken from "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study"

DPE Contingency Capital Cost	$1,074,800
DPE Contingency O&M Cost	$449,800

Table A-3

Alternative 4 -Partial Capping/ Thermally Enhanced SVE/ICs — **COST ESTIMATE SUMMARY**

Site:	Omega Chemical	**Description:**	This alternative would involve using ERH to enhance SVE. The ERH system would include installation of 220 electrodes at an average depth of 75 feet, installation of 234 soil vapor extraction wells, and installation of 21 temperature monitoring points. No installation of shallow VMP required for this alternative (use existing wells). Installation of 3 deep VMP. System would remove approximately 2800 scfm. Vapor extraction wells would be piped to the blower. Extracted vapor would pass through air/water separator and than through VGAC prior to discharge into the atmosphere. Period of performance for this alternative assumed to be 1 year.
Location:	Whittier, California		
Phase:	FS (+30/-50%)		
Base Year:	2008		
Date:	May 7, 2008		

CAPITAL COSTS

Description		Cost Backup Reference	Qty	Unit	Unit Cost	Total Cost	Comments
Contractor Work Plans		CW-1	1	LS	$61,000	$61,000	Standard RA documents, including storm water management
Mobilization/Demobilization of Equipment		CW-9	1	LS	$1,225,700	$1,225,700	
Permitting		CW-8	1	LS	$62,000	$62,000	
ER SVE							
	Electrodes with VRW Installation Installation	CW-5	220	Each	$14,200	$3,124,000	
	SVE wells installation	CW-5	14	EA	$13,100	$183,400	
	TMP Installation	CW-5	21	Each	$10,100	$212,100	
	Deep VMP Installation	CW-4	3	Each	$5,800	$17,400	
	SVE System (includes air/water separator, blower, cooling tower, VGAC unit, all instrumentstion and controls, and treatment building)	CW-6	1	Each	$728,000	$728,000	
	Piping	CW-7	1	LS	$656,700	$656,700	
Institutional Controls Package		CW-11	1	LS	$28,100	$28,100	
					SUBTOTAL	$6,298,400	
	Contingency (scope and bid)		20%			$1,259,700	
					SUBTOTAL	$7,558,100	
	Project Management		10%			$755,800	
	Technical Support		15%			$1,133,700	
					TOTAL CAPITAL COST	**$9,447,600**	

ANNUAL COSTS - Year 1

Description		Reference*	Qty	Unit	Unit Cost	Total Cost	Comments
O&M Costs 0-1		CW-11	1	LS	$4,647,200	$4,647,200	
					SUBTOTAL	$4,647,200	
	Contingency (scope and bid)		20%			$929,400	
					SUBTOTAL	$5,576,600	
	Construction Management		10%			$557,700	
	Engineering		15%			$836,500	
					TOTAL O&M COST 0 -1	**$6,970,800**	

PERIODIC COST - Year 5

Description		Cost Backup Reference	Qty	Unit	Unit Cost	Total Cost	Comments
Institutional Controls Package Updates		CW-9	1	LS	$9,200	$9,200	
					SUBTOTAL	$9,200	
	Contingency (scope and bid)		20%			$1,800	
					SUBTOTAL	$11,000	
	Project Management		10%			$1,100	
	Technical Support		15%			$1,700	
					TOTAL PERIODIC COSTS	**$13,800**	

PRESENT VALUE ANALYSIS

COST TYPE	YEAR(S)	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)**	PRESENT VALUE	Comments
Capital Costs	0	$9,447,600	1	$9,447,600	
Annual Costs	1	$6,970,800	0.935	$6,514,900	
Periodic Costs	5	$1,700	0.713	$1,212	
		TOTAL PRESENT VALUE OF ALTERNATIVE 4		**$15,960,000**	

*All cost backup reference sheets are presented in Appendix A of the Omega FS

** 7 % discount factors, based on OMB guidance, are taken from "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study"

DPE Contingency Capital Cost	$1,074,800
DPE Contingency O&M Cost	$449,800

CW-1: CONTRACTOR WORK PLANS

Site:	**Omega Chemical**	Created by: E. Borisova	Date: 26-Sep-07
Location:	**Whittier, California**	Checked by:	Date:
Base Year:	**2008**		
Date:	**May 7, 2008**		

Contractor Work Plans

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Remedial Action Work Plan	48	HR	1.00	$100.00	$100.00	$0.00	$0.00	$60.96	$0.00	$160.96	$7,726	1.25	1.18	$11,048	15%	8%	$14,000	P		
Health and Safety Plan	32	HR	1.00	$100.00	$100.00	$0.00	$0.00	$40.64	$0.00	$140.64	$4,500	1.25	1.18	$6,436	15%	8%	$8,000	P		
Security Plan	32	HR	1.00	$100.00	$100.00	$0.00	$0.00	$40.64	$0.00	$140.64	$4,500	1.25	1.18	$6,436	15%	8%	$8,000	P		
Environmentall Protection Plan	32	HR	1.00	$100.00	$100.00	$0.00	$0.00	$40.64	$0.00	$140.64	$4,500	1.25	1.18	$6,436	15%	8%	$8,000	P		
Stormwater Management Plan	40	HR	1.00	$65.00	$65.00	$11.74	$11.74	$28.53	$0.00	$105.27	$4,211	1.25	1.18	$6,021	15%	8%	$7,000	P		
Indoor Air Monitoring Work Plan	32	HR	1.00	$100.00	$100.00	$0.00	$0.00	$40.64	$0.00	$140.64	$4,500	1.25	1.18	$6,436	15%	8%	$8,000	P		
Quality Control Plan	32	HR	1.00	$100.00	$100.00	$0.00	$0.00	$40.64	$0.00	$140.64	$4,500	1.25	1.18	$6,436	15%	8%	$8,000	P		
														TOTAL UNIT COST:			$61,000			
Stormwater Management Plan (Hot spot excavation only)	32	HR	1.00	$65.00	$65.00	$11.74	$11.74	$28.53	$0.00	$105.27	$3,368.64	1.25	1.18	$4,817	15%	8%	$6,000	P		

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543

Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote

L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY	quantity
LS	lump sum
EQUIP	equipment
MATL	material
HPF	HTRW productivity factor
ADJ LABOR	adjusted labor for HFP
ADJ EQUIP	adjusted equipment for HFP
UNMOD UC	unmodified unit cost
UNMOD LIC	unmodified line item cost
EF	escalation factor
AF	area factor
UNBUR LIC	unburdened line item cost
PC OH	prime contractor overhead
PC PF	prime contractor profit

CW-2: Hot Spot Excavation

Site:	**Omega Chemical**	Created by:	E. Borisova	Date:	26-Sep-07
Location:	**Whittier, California**	Checked by:		Date:	
Base Year:	**2008**				
Date:	**May 7, 2008**				

Costs for hot spot excavation. Costs include excavation of the 5,000 square foot area to the depth of 15 feet.

Is dewatering required? Where is the groundwater level?

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC	CITATION		COMMENTS
Site Preparation																				
Pavement Removal	560	SY	0.85	$7.00	$8.24	$6.00	$7.06	$10.00	$0.00	$25	$14,165	1.25	1.18	$69,000	15%	8%	$85,700	C	2220.875	Assumed 6" pavement
Install and Remove Sheet Piles	5000	SF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$60.00	$60	$300,000	1.25	1.18	$429,000	15%	8%	$532,800	P	N/A	
Excavation and Disposal Costs																				
Excavation	2778	CY	0.85	$0.87	$1.02	$3.20	$3.76	$3.10	$0.00	$8	$21,905	1.25	1.18	$31,000	15%	8%	$38,500	P	N/A	3 CY hydraulic backhoe, continuous footing , common earth, 15 feet depth
Transportation of Soil to Landfill - RCRA	3589	TN	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$40.00	$40	$143,556	1.25	1.18	$205,000	15%	8%	$254,600	P	N/A	Lauding and hauling (1.25 tn/cy)
Landfill Disposal - RCRA	3589	TN	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$128.00	$128	$459,378	1.25	1.18	$657,000	15%	8%	$816,000	P	N/A	
Post Excavation																				
Borrow and Backfill	3000	CY	0.85	$3.03	$3.56	$2.75	$3.24	$18.15	$0.00	$25	$74,832	1.25	1.18	$107,000	15%	8%	$132,900	P	N/A	
Compaction	3000	CY	0.85	$1.14	$1.34	$0.36	$0.43	$0.00	$0.00	$2	$5,296	1.25	1.18	$8,000	15%	8%	$9,900	C	02315.300.6220	
Paving	5000	SF	0.85	$0.14	$0.16	$0.16	$0.19	$0.14	$0.00	$0	$2,465	1.25	1.18	$4,000	15%	8%	$5,000	P	N/A	Aphaltic concrete
														SUBTOTAL UNIT COST:			$1,875,400			
Engineering	5	%															$92,000	P	N/A	Aphaltic concrete
														TOTAL UNIT COST:			$1,967,400			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - *costs are from previous work or vendor quote*
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "C" PPE. An HPF of 0.85 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY	quantity	LS lump sum
EQUIP	equipment	
MATL	material	
HPF	HTRW productivity factor	
ADJ LABOR	adjusted labor for HFP	
ADJ EQUIP	adjusted equipment for HFP	
UNMOD UC	*unmodified unit cost*	
UNMOD LIC	unmodified line item cost	
EF	escalation factor	
AF	area factor	
UNBUR LIC	unburdened line item cost	
PC OH	prime contractor overhead	
PC PF	prime contractor profit	
BUR LIC	burdened line item cost	

CW-3: SVE WELL INSTALLATION

Site:	Omega Chemical	Created by:	E. Borisova	Date: 26-Sep-07
Location:	Whittier, California	Checked by:		Date:
Base Year:	2008			
Date:	May 7, 2008			

Costs for installation of SVE well Alternatives 2 and 3. Costs are per well.

Shallow to Medium SVE Wells (25 ft bgs)

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Drill and install 4 inch vapor wells	27	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$80.00	$94	$2,541	1.00	1.00	$2,500	15%	8%	$3,100	P	N/A	SVE test driller costs, bore hole 2 feet longer than well depth
Concrete Coring and cutting	2	HR	0.85	$125.00	$147.06	$11.14	$13.11	$0.00	$0.00	$160	$320	1.00	1.00	$300	15%	8%	$400	P	N/A	
Flush mounted surface completions	1	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$235	$235	1.00	1.00	$200	15%	8%	$200	P	N/A	
Containment drums for decon water	1	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$42.00	$49	$49	1.00	1.00	$50	15%	8%	$60	P	N/A	
Decontamination trailer rental	0.25	DAY	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$150.00	$176	$44	1.00	1.00	$40	15%	8%	$50	P	N/A	
Forklift and dumpster	0.25	DAY	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$320.00	$376	$94	1.00	1.00	$100	15%	8%	$100	P	N/A	
Well Vault, Traffic Loading, 4' by 4' SS	1	EA	0.85	$715.83	$842.15	$1,253.00	$1,474.12	$831.69	$0.00	$3,148	$3,148	1.00	1.00	$3,100	15%	8%	$4,000	P	N/A	1 per well
Disposal of Cuttings	2	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$385.00	$453	$906	1.25	1.18	$1,300	15%	8%	$2,000	P	N/A	Cost per drum, assume 3 per well
														TOTAL UNIT COST:			$9,900			

Existing SVE Wells

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Well Vault, Traffic Loading, 4' by 4' SS	1	EA	0.85	$180.00	$211.76	$0.00	$0.00	$2,100.00	$0.00	$2,312	$2,312	1.00	1.00	$2,300	15%	8%	$2,900	P	N/A	1 per well
														TOTAL UNIT COST:			$2,900			

Deep SVE Wells (75 ft bgs)

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Drill and install 4 inch vapor wells	77	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$80.00	$94	$7,247	1.00	1.00	$7,200	15%	8%	$8,900	P	N/A	bore hole 2 feet longer than well depth
Concrete Coring and cutting	2	HR	0.85	$125.00	$147.06	$11.14	$13.11	$0.00	$0.00	$160	$320	1.00	1.00	$300	15%	8%	$400	P	N/A	9 per well
Flush mounted surface completions	1	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$235	$235	1.00	1.00	$200	15%	8%	$200	P	N/A	2000 cost
Containment drums for decon water	1	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$42.00	$49	$49	1.00	1.00	$50	15%	8%	$60	P	N/A	
Decontamination trailer rental	0.25	DAY	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$150.00	$176	$44	1.00	1.00	$40	15%	8%	$50	P	N/A	1 per well
Forklift and dumpster	0.25	DAY	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$320.00	$376	$94	1.00	1.00	$100	15%	8%	$100	P	N/A	2' above screen, 1' below
Well Vault, Traffic Loading, 4' by 4' SS	1	EA	0.85	$715.83	$842.15	$1,253.00	$1,474.12	$831.69	$0.00	$3,148	$3,148	1.00	1.00	$3,100	15%	8%	$4,000	P	NA	Remainder of annulus, vendor quote
Disposal of Cuttings	3	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$385.00	$453	$1,359	1.25	1.18	$1,900	15%	8%	$2,000	P	N/A	Cost per drum, assume 3 per well
														TOTAL UNIT COST:			$15,700			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "C" PPE. An HPF of 0.85 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY	quantity
EQUIP	equipment
MATL	material
HPF	HTRW productivity factor
ADJ LABOR	adjusted labor for HFP
ADJ EQUIP	adjusted equipment for HFP
UNMOD UC	unmodified unit cost
UNMOD LIC	unmodified line item cost
EF	escalation factor
AF	area factor
UNBUR LIC	unburdened line item cost
PC OH	prime contractor overhead
PC PF	prime contractor profit
BUR LIC	burdened line item cost
LS	lump sum

CW-4: MONITORING POINTS INSTALLATION

Site: Omega Chemical
Location: Whittier, California
Base Year: 2008
Date: May 7, 2008

Created by: E. Borisova Date: 26-Sep-07
Checked by: Date:

Costs for installation of Vapor Monitoring Points (VMP) Alternatives 2 and 3. Costs are per VMP.

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC	CITATION		COMMENTS
MPV dual depth 5-7 ft screened, 24' bgs	1	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$3,465	$4,076	$4,076	1.00	1.00	$4,076.47	15%	8%	$5,100	P	N/A	
														TOTAL UNIT COST:			$5,100			
MPV 35-40 ft screened, 60' bgs	1	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$3,960	$4,659	$4,659	1.00	1.00	$4,658.82	15%	8%	$5,800	P	N/A	
														TOTAL UNIT COST:			$5,800			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "C" PPE. An HPF of 0.85 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY quantity
EQUIP equipment
MATL material
HPF HTRW productivity factor
ADJ LABOR adjusted labor for HFP
ADJ EQUIP adjusted equipment for HFP
UNMOD UC unmodified unit cost
UNMOD LIC unmodified line item cost
EF escalation factor
AF area factor
UNBUR LIC unburdened line item cost
PC OH prime contractor overhead
PC PF prime contractor profit
BUR LIC burdened line item cost
LS lump sum

CW-5: Electrodes, VR wells, and TM points installation

Site:	**Omega Chemical**	Created by: E. Borisova	Date: 26-Sep-07
Location:	**Whittier, California**	Checked by:	Date:
Base Year:	**2008**		
Date:	**May 7, 2008**		

Costs for installation of electrodes, VR wells, and TMP installation. Costs are per well.

Electrodes

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Drill and install electrodes and VR wells	75	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$72.60	$85	$6,406	1.00	1.00	$6,406	15%	8%	$8,000	V	N/A	SVE test driller costs, bore hole 2 feet longer than well depth
Concrete Coring and cutting	3	HR	0.85	$125.00	$147.06	$11.14	$13.11	$0.00	$0.00	$160	$480	1.00	1.00	$480	15%	8%	$600	V	N/A	
Well Vault, Traffic Loading, 4' by 4' SS	1	EA	0.85	$715.83	$842.15	$1,253.00	$1,474.12	$831.69	$0.00	$3,148	$3,148	1.00	1.00	$3,100	15%	8%	$4,000	P	N/A	1 per well
Disposal of Cuttings	2	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$385.00	$453	$906	1.25	1.18	$1,295	15%	8%	$1,600	E	33-19-7205	Cost per drum, assume 3 per well
														TOTAL UNIT COST:			$14,200			

Vapor Recovery Wells

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Drill and install VR wells	65	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$72.60	$85	$5,552	1.00	1.00	$5,552	15%	8%	$6,900	V	N/A	SVE test driller costs, bore hole 2 feet longer than well depth
Concrete Coring and cutting	3	HR	0.85	$125.00	$147.06	$11.14	$13.11	$0.00	$0.00	$160	$480	1.00	1.00	$480	15%	8%	$600	V	N/A	
Well Vault, Traffic Loading, 4' by 4' SS	1	EA	0.85	$715.83	$842.15	$1,253.00	$1,474.12	$831.69	$0.00	$3,148	$3,148	1.00	1.00	$3,100	15%	8%	$4,000	P	N/A	1 per well
Disposal of Cuttings	2	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$385.00	$453	$906	1.25	1.18	$1,295	15%	8%	$1,600	E	33-19-7205	Cost per drum, assume 3 per well
														TOTAL UNIT COST:			$13,100			

Temperature Monitoring Points

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Drill and install TMP	77	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$34.70	$41	$3,143	1.00	1.00	$3,143	15%	8%	$3,900	V	N/A	SVE test driller costs, bore hole 2 feet longer than well depth
Concrete Coring and cutting	3	HR	0.85	$125.00	$147.06	$11.14	$13.11	$0.00	$0.00	$160	$480	1.00	1.00	$480	15%	8%	$600	V	N/A	
Well Vault, Traffic Loading, 4' by 4' SS	1	EA	0.85	$715.83	$842.15	$1,253.00	$1,474.12	$831.69	$0.00	$3,148	$3,148	1.00	1.00	$3,100	15%	8%	$4,000	P	N/A	1 per well
Disposal of Cuttings	2	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$385.00	$453	$906	1.25	1.18	$1,295	15%	8%	$1,600	E	33-19-7205	Cost per drum, assume 3 per well
														TOTAL UNIT COST:			$10,100			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "C" PPE. An HPF of 0.85 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY	quantity
EQUIP	equipment
MATL	material
HPF	HTRW productivity factor
ADJ LABOR	adjusted labor for HFP
ADJ EQUIP	adjusted equipment for HFP
UNMOD UC	unmodified unit cost
UNMOD LIC	unmodified line item cost
EF	escalation factor
AF	area factor
UNBUR LIC	unburdened line item cost
PC OH	prime contractor overhead
PC PF	prime contractor profit
BUR LIC	burdened line item cost
LS	lump sum

CW-6: SVE System

Site: Omega Chemical
Location: Whittier, California
Base Year: 2008
Date: May 7, 2008

Created by: E. Borisova Date: 26-Sep-07
Checked by: Date:

Installation of SVE system Alternatives 2 and 3

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Blower Skid																				
Blower 1600 scfm 15" Hg	2	EA	1.00	$0.00	$0.00	$57,000.00	$57,000.0	$0.00	$0.00	$57,000.00	$114,000	1.00	1.00	$114,000	15%	8%	$141,600	P	N/A	
Pump Package	2	EA	1.00	$0.00	$0.00	$2,200.00	$2,200.00	$0.00	$0.00	$2,200.00	$4,400	1.00	1.00	$4,400	15%	8%	$5,500	P	N/A	
Air/Water Separator	2	EA	1.00	$0.00	$0.00	$11,000.00	$11,000.00	$0.00	$0.00	$11,000.00	$22,000	1.00	1.00	$22,000	15%	8%	$27,300	P	N/A	
Noise Enclosure	2	EA	1.00	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	$0.00	$5,000.00	$10,000	1.00	1.00	$10,000	15%	8%	$12,400	P	N/A	
Control Panel	2	EA	1.00	$0.00	$0.00	$18,000.00	$18,000.00	$0.00	$0.00	$18,000.00	$36,000	1.00	1.00	$36,000	15%	8%	$44,700	P	N/A	
Skid Utilities/Electrical	2	EA	1.00	$0.00	$0.00	$25,000.00	$25,000.00	$0.00	$0.00	$25,000.00	$50,000	1.00	1.00	$50,000	15%	8%	$62,100	P	N/A	
Piping, Instrumentation and Misc.	2	EA	1.00	$0.00	$0.00	$25,000.00	$25,000.00	$0.00	$0.00	$25,000.00	$50,000	1.00	1.00	$50,000	15%	8%	$62,100	P	N/A	
Labor/Installation	2	EA	1.00	$3,000.00	$3,000.00	$0.00	$0.00	$0.00	$0.00	$3,000.00	$6,000	1.00	1.00	$6,000	15%	8%	$7,500	P	N/A	
VGAC Skid																				
Carbon Vessels	2	EA	1.00	$0.00	$0.00	$18,000.00	$18,000.00	$0.00	$0.00	$18,000.00	$36,000	1.00	1.00	$36,000	15%	8%	$44,700	P	N/A	
Lead/Lag Piping Manifold	1	EA	1.00	$0.00	$0.00	$15,000.00	$15,000.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
Virgin Carbon	16000	LBS	1.00	$0.00	$0.00	$0.00	$0.00	$2.00	$0.00	$2.00	$32,000	1.00	1.00	$32,000	15%	8%	$39,700	P	N/A	
Labor/Installation	1	EA	1.00	$2,500.00	$2,500.00	$0.00	$0.00	$0.00	$0.00	$2,500.00	$2,500	1.00	1.00	$2,500	15%	8%	$3,100	P	N/A	
Electrical Power Distribution																				
Electrical Service	1	EA	1.00	$30,000.00	$30,000.00	$0.00	$0.00	$0.00	$0.00	$30,000.00	$30,000	1.00	1.00	$30,000	15%	8%	$37,300	P	N/A	
Power Distribution to process equipment	1	EA	1.00	$15,000.00	$15,000.00	$0.00	$0.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
I&C and programming	1	EA	1.00	$15,000.00	$15,000.00	$10,000.00	$0.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
Delivery/Start Up																				
Price to site	1	EA	1.00	$8,000.00	$8,000.00	$0.00	$0.00	$0.00	$0.00	$8,000.00	$8,000	1.00	1.00	$8,000	15%	8%	$9,900	P	N/A	
Start Up Assistance	1	EA	1.00	$13,000.00	$13,000.00	$0.00	$0.00	$0.00	$0.00	$13,000.00	$13,000	1.00	1.00	$13,000	15%	8%	$16,100	P	N/A	
Building																				
Pre-engineered buildings	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100,000.00	$100,000	1.00	1.00	$100,000	15%	8%	$124,200	P	N/A	
														Total Unit Cost			$694,000			

Installation of SVE system Alternative 4

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Blower Skid																				
Blower 1600 scfm 15" Hg	2	EA	1.00	$0.00	$0.00	$57,000.00	$57,000.0	$0.00	$0.00	$57,000.00	$114,000	1.00	1.00	$114,000	15%	8%	$141,600	P	N/A	
Pump Package	2	EA	1.00	$0.00	$0.00	$2,200.00	$2,200.00	$0.00	$0.00	$2,200.00	$4,400	1.00	1.00	$4,400	15%	8%	$5,500	P	N/A	
Heat Exchanger	1	EA	1.00	$0.00	$0.00	$11,000.00	$11,000.00	$0.00	$0.00	$11,000.00	$11,000	1.00	1.00	$11,000	15%	8%	$13,700	P	N/A	
Air/Water Separator	2	EA	1.00	$0.00	$0.00	$11,000.00	$11,000.00	$0.00	$0.00	$11,000.00	$22,000	1.00	1.00	$22,000	15%	8%	$27,300	P	N/A	
Noise Enclosure	2	EA	1.00	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	$0.00	$5,000.00	$10,000	1.00	1.00	$10,000	15%	8%	$12,400	P	N/A	
Control Panel	2	EA	1.00	$0.00	$0.00	$18,000.00	$18,000.00	$0.00	$0.00	$18,000.00	$36,000	1.00	1.00	$36,000	15%	8%	$44,700	P	N/A	
Skid Utilities/Electrical	2	EA	1.00	$0.00	$0.00	$25,000.00	$25,000.00	$0.00	$0.00	$25,000.00	$50,000	1.00	1.00	$50,000	15%	8%	$62,100	P	N/A	
Piping, Instrumentation and Misc.	2	EA	1.00	$0.00	$0.00	$25,000.00	$25,000.00	$0.00	$0.00	$25,000.00	$50,000	1.00	1.00	$50,000	15%	8%	$62,100	P	N/A	
Labor/Installation	2	EA	1.00	$3,000.00	$3,000.00	$0.00	$0.00	$0.00	$0.00	$3,000.00	$6,000	1.00	1.00	$6,000	15%	8%	$7,500	P	N/A	
Cooling Tower	1	EA	1.00	$16,000.00	$16,000.00	$0.00	$0.00	$0.00	$0.00	$16,000.00	$16,000	1.00	1.00	$16,000	15%	8%	$19,900	P	N/A	
VGAC Skid																				
Carbon Vessels	2	EA	1.00	$0.00	$0.00	$18,000.00	$18,000.00	$0.00	$0.00	$18,000.00	$36,000	1.00	1.00	$36,000	15%	8%	$44,700	P	N/A	
Lead/Lag Piping Manifold	1	EA	1.00	$0.00	$0.00	$15,000.00	$15,000.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
Virgin Carbon	16000	LBS	1.00	$0.00	$0.00	$0.00	$0.00	$2.00	$0.00	$2.00	$32,000	1.00	1.00	$32,000	15%	8%	$39,700	P	N/A	
Labor/Installation	1	EA	1.00	$2,500.00	$2,500.00	$0.00	$0.00	$0.00	$0.00	$2,500.00	$2,500	1.00	1.00	$2,500	15%	8%	$3,100	P	N/A	
Electrical Power Distribution																				
Electrical Service	1	EA	1.00	$30,000.00	$30,000.00	$0.00	$0.00	$0.00	$0.00	$30,000.00	$30,000	1.00	1.00	$30,000	15%	8%	$37,300	P	N/A	
Power Distribution to process equipment	1	EA	1.00	$15,000.00	$15,000.00	$0.00	$0.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
I&C and programming	1	EA	1.00	$15,000.00	$15,000.00	$10,000.00	$0.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
Delivery/Start Up																				
Price to site	1	EA	1.00	$8,000.00	$8,000.00	$0.00	$0.00	$0.00	$0.00	$8,000.00	$8,000	1.00	1.00	$8,000	15%	8%	$9,900	P	N/A	
Start Up Assistance	1	EA	1.00	$13,000.00	$13,000.00	$0.00	$0.00	$0.00	$0.00	$13,000.00	$13,000	1.00	1.00	$13,000	15%	8%	$16,100	P	N/A	
Building																				
Pre-engineered buildings	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$100,000.00	$100,000	1.00	1.00	$100,000	15%	8%	$124,200	P	N/A	
														Total Unit Cost			$728,000			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "C" PPE. An HPF of 0.85 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor

Abbreviations:

QTY	quantity
EQUIP	equipment
MATL	material
HPF	HTRW productivity factor
ADJ LABOR	adjusted labor for HFP
ADJ EQUIP	adjusted equipment for HFP
UNMOD UC	unmodified unit cost
UNMOD LIC	unmodified line item cost
EF	escalation factor
AF	area factor
UNBUR LIC	unburdened line item cost
PC OH	prime contractor overhead
PC PF	prime contractor profit
BUR LIC	burdened line item cost
LS	lump sum

Table A-4

CW-7: PIPING

Site:	Omega Chemical	Created by:	E. Borisova	Date:	26-Sep-07
Location:	Whittier, California	Checked by:		Date:	
Base Year:	2008				
Date:	May 7, 2008				

Total Unit Cost	#REF!

Alternatives 2 and 3

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
4" diameter pipe	3500	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$32	$38	$131,765	1.25	1.18	$188,424	15%	8%	$234,000	P	N/A	Cost based on 4 inch fiberglass cost . Assumed 60% for fittings
6" diameter pipe	500	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$42	$49	$24,706	1.25	1.18	$35,329	15%	8%	$43,900	P	N/A	Cost based on 6 inch fiberglass cost . Assumed 60% for fittings
														Total Unit Cost			$277,900			

Alternative 4

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
2" diameter pipe	9685	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$20	$24	$227,882	1.25	1.18	$325,872	15%	8%	$404,700	P	N/A	Cost based on 4 inch fiberglass cost . Assumed 60% for fittings
4" diameter pipe	1800	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$32	$38	$67,765	1.25	1.18	$96,904	15%	8%	$120,400	P	N/A	Cost based on 4 inch fiberglass cost . Assumed 60% for fittings
6" diameter pipe	1500	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$42	$49	$74,118	1.25	1.18	$105,988	15%	8%	$131,600	P	N/A	Cost based on 6 inch fiberglass cost . Assumed 60% for fittings
														Total Unit Cost			$656,700			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "C" PPE. An HPF of 0.85 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY	quantity
LS	lump sum
EQUIP	equipment
MATL	material
HPF	HTRW productivity factor
ADJ LABOR	adjusted labor for HFP
ADJ EQUIP	adjusted equipment for HFP
UNMOD UC	unmodified unit cost
UNMOD LIC	unmodified line item cost
EF	escalation factor
AF	area factor
UNBUR LIC	unburdened line item cost
PC OH	prime contractor overhead
PC PF	prime contractor profit
BUR LIC	burdened line item cost

CW-8: Permitting

Site:	Omega Chemical	Created by:	E. Borisova	Date:	26-Sep-07
Location:	Whittier, California	Checked by:		Date:	
Base Year:	2008				
Date:	May 7, 2008				

Permitting

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
City Permitting	100	HR	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100	$10,000	1.00	1.00	$10,000	15%	8%	$12,400	P	N/A	
City Permitting Fees	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$13,000.00	$0.00	$13,000	$13,000	1.00	1.00	$13,000	15%	8%	$16,100	P	N/A	
SCAQMD Permitting	100	HR	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100	$10,000	1.00	1.00	$10,000	15%	8%	$12,400	P	N/A	
SCAQMD Permitting Fees	1	EA	1.00	$0.00	$0.00	$0.00	$0.00	$7,000.00	$0.00	$7,000	$7,000	1.00	1.00	$7,000	15%	8%	$8,700	P	N/A	
SCAQMD Monitoring and Sampling Plan	100	HR	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100	$10,000	1.00	1.00	$10,000	15%	8%	$12,400	P	N/A	
														Total Unit Cost			$62,000			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY quantity
EQUIP equipment
MATL material
HPF HTRW productivity factor
ADJ LABOR adjusted labor for HFP
ADJ EQUIP adjusted equipment for HFP
UNMOD UC unmodified unit cost
UNMOD LIC unmodified line item cost
EF escalation factor
AF area factor
UNBUR LIC unburdened line item cost
PC OH prime contractor overhead
PC PF prime contractor profit
LS lump sum

CW-9: MOBILIZATION/DEMOBILIZATION

Site:	**Omega Chemical**	Created by:	E. Borisova	Date:	26-Sep-07
Location:	**Whittier, California**	Checked by:		Date:	
Base Year:	**2008**				
Date:	**May 7, 2008**				

Mob/Demob Alternatives 2 and 3

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Mob/Demob drilling Rig and Crew	3	EA	0.95	$500.00	$526.32	$1,000.00	$1,052.63	$0.00	$0.00	$1,578.95	$4,736.84	1.25	1.18	$6,774	15%	8%	$8,400	E	33-01-01	
Mob/Demob other equipment	1	LS	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$45,000.00	$45,000.00	$45,000.00	1.25	1.18	$64,350	15%	8%	$79,900	P	N/A	
														Total Unit Cost			$88,300			

Mob/Demob Alternative 4

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Mob/Demob drilling Rig and Crew	6	EA	0.95	$500.00	$526.32	$1,000.00	$1,052.63	$0.00	$0.00	$1,578.95	$9,473.68	1.25	1.18	$13,547	15%	8%	$16,800	E	33-01-01	
Mob/Demob other equipment	1	LS	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$45,000.00	$45,000.00	$45,000.00	1.25	1.18	$64,350	15%	8%	$79,900	P	N/A	
Electrode materials mobilization	1	LS	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$909,000.00	$909,000.00	$909,000.00	1.00	1.00	$909,000	15%	8%	$1,129,000	P	N/A	
														Total Unit Cost			$1,225,700			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "D" PPE. An HPF of 0.95 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY	quantity
EQUIP	equipment
MATL	material
HPF	HTRW productivity factor
ADJ LABOR	adjusted labor for HFP
ADJ EQUIP	adjusted equipment for HFP
UNMOD UC	unmodified unit cost
UNMOD LIC	unmodified line item cost
EF	escalation factor
AF	area factor
UNBUR LIC	unburdened line item cost
PC OH	prime contractor overhead
PC PF	prime contractor profit
BUR LIC	burdened line item cost
LS	lump sum

CW-10 O&M Costs

Site:	**Omega Chemical**	Created by:	E. Borisova	Date: 26-Sep-07
Location:	**Whittier, California**	Checked by:		Date:
Base Year:	**2008**			
Date:	**May 7, 2008**			

O&M Cost Alternatives 2 and 3 Year 0-1

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Treatment System Engineering and Complience reporting	80	HR	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100.00	$8,000.00	1.25	1.18	$11,440	15%	8%	$14,200	P	N/A	
Treatment System O&M Labor (first month daily 1 crews)	1	EA	1.00	$10,000.00	$10,000.00	$0.00	$0.00	$0.00	$0.00	$10,000.00	$10,000.00	1.25	1.18	$14,300	15%	8%	$17,800	P	N/A	assumed 25 days 2 people @$25/hrs each
Treatment System O&M Labor (1/week, 1 crew)	12	MONTH	1.00	$400.00	$400.00	$0.00	$0.00	$0.00	$0.00	$400.00	$4,800.00	1.25	1.18	$6,864	15%	8%	$8,500	P	N/A	
Treatment System O&M Engineer (as needed)	12	MONTH	1.00	$3,200.00	$3,200.00	$0.00	$0.00	$0.00	$0.00	$3,200.00	$38,400.00	1.25	1.18	$54,912	15%	8%	$68,200	P	N/A	
Equipment maintenance (filter changeout, lubrication)	3	EA	1.00	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	$0.00	$5,000.00	$15,000.00	1.25	1.18	$21,450	15%	8%	$26,600	P	N/A	
Blower Maintenance	3	EA	1.00	$0.00	$0.00	$4,500.00	$4,500.00	$0.00	$0.00	$4,500.00	$13,500.00	1.25	1.18	$19,305	15%	8%	$24,000	P	N/A	
Electricity Usage	777600	KW	1.00	$0.00	$0.00	$0.00	$0.00	$0.12	$0.00	$0.12	$93,312.00	1.25	1.18	$133,436	15%	8%	$165,700	P	N/A	
Instruments Rental	12	MONTH	1.00	$0.00	$0.00	$1,000.00	$1,000.00	$0.00	$0.00	$1,000.00	$12,000.00	1.25	1.18	$17,160	15%	8%	$21,300	P	N/A	
Vapor Carbon Disposal (four changeouts @ 8000 lbs each)	32000	LBS	1.00	$0.00	$0.00	$0.00	$0.00	$2.00	$0.00	$2.00	$64,000.00	1.25	1.18	$91,520	15%	8%	$113,700	P	N/A	
SCAQMD Source Testing Third Party Firm	1	EA	1.00	$30,000.00	$30,000.00	$0.00	$0.00	$0.00	$0.00	$30,000.00	$30,000.00	1.25	1.18	$42,900	15%	8%	$53,300	P	N/A	
SCAQMD Source Testing Supervision	90	HRS	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100.00	$9,000.00	1.25	1.18	$12,870	15%	8%	$16,000	P	N/A	
Indor air monitoring program (sample collection at 8 bldg and QA/QC sampling collection, analizes, reporting, product use inventory)	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$20,010.00	$20,010.00	$20,010.00	1.25	1.18	$28,614	15%	8%	$35,500	P	N/A	3 samples/bldg + 8QA/QC samples
SVE monitoring (inlet, intermediate and exhaust samples and QA/QC samples analyzed for EPA 8015M) by a Third-Party Firm. Assuming three samples first week and monthly thereafter.	12	MONTH	1.00	$0.00	$0.00	$0.00	$0.00	$980.00	$0.00	$950.00	$11,400.00	1.25	1.18	$16,302	15%	8%	$20,200	P	N/A	
Maintenance of existing paved area	1	EA	1.00	$3,500.00	$3,500.00	$0.00	$0.00	$0.00	$0.00	$3,500.00	$3,500.00	1.25	1.18	$5,005	15%	8%	$6,200	P	N/A	
Engineering, Supervision, and Reporting (quaterly)	4	EA	1.00	$8,500.00	$8,500.00	$0.00	$0.00	$0.00	$0.00	$8,500.00	$34,000.00	1.25	1.18	$48,620	15%	8%	$60,400	P	N/A	
														Total Unit Cost			**$651,600**			

O&M Annual Cost Year 2-5

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Treatment System Engineering and Complience reporting	80	HR	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100.00	$8,000.00	1.25	1.18	$11,440	15%	8%	$14,200	P	N/A	
Treatment System O&M Labor (1/week, 1 crew)	12	MONTH	1.00	$400.00	$400.00	$0.00	$0.00	$0.00	$0.00	$400.00	$4,800.00	1.25	1.18	$6,864	15%	8%	$8,500	P	N/A	
Treatment System O&M Engineer (as needed)	12	MONTH	1.00	$2,400.00	$2,400.00	$0.00	$0.00	$0.00	$0.00	$2,400.00	$28,800.00	1.25	1.18	$41,184	15%	8%	$51,200	P	N/A	
Equipment maintenance (filter changeout, lubrication)	3	EA	1.00	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	$0.00	$5,000.00	$15,000.00	1.25	1.18	$21,450	15%	8%	$26,600	P	N/A	
Blower Maintenance	3	EA	1.00	$0.00	$0.00	$5,500.00	$5,500.00	$0.00	$0.00	$5,500.00	$16,500.00	1.25	1.18	$23,595	15%	8%	$29,300	P	N/A	
Electricity Usage	777600	KW	1.00	$0.00	$0.00	$0.00	$0.00	$0.12	$0.00	$0.12	$93,312.00	1.25	1.18	$133,436	15%	8%	$165,700	P	N/A	
Instruments Rental	12	MONTH	1.00	$0.00	$0.00	$1,000.00	$1,000.00	$0.00	$0.00	$1,000.00	$12,000.00	1.25	1.18	$17,160	15%	8%	$21,300	P	N/A	
Vapor Carbon Disposal (3 changeout a year)	24000	LBS	1.00	$0.00	$0.00	$0.00	$0.00	$2.00	$0.00	$2.00	$48,000.00	1.25	1.18	$68,640	15%	8%	$85,300	P	N/A	
SCAQMD Source Testing Third Party Firm	1	EA	1.00	$20,000.00	$20,000.00	$0.00	$0.00	$0.00	$0.00	$20,000.00	$20,000.00	1.25	1.18	$28,600	15%	8%	$35,500	P	N/A	
SCAQMD Source Testing Supervision	90	HRS	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100.00	$9,000.00	1.25	1.18	$12,870	15%	8%	$16,000	P	N/A	
SVE monitoring (inlet, intermediate and exhaust samples and QA/QC samples analyzed for EPA 8015M) by a Third-Party Firm. Assuming three samples first week and monthly thereafter.	12	MONTH	1.00	$0.00	$0.00	$0.00	$0.00	$980.00	$0.00	$950.00	$11,400.00	1.25	1.18	$16,302	15%	8%	$20,200	P	N/A	
Maintenance of existing paved area	1	EA	1.00	$3,500.00	$3,500.00	$0.00	$0.00	$0.00	$0.00	$3,500.00	$3,500.00	1.25	1.18	$5,005	15%	8%	$6,200	P	N/A	
Engineering, Supervision, and Reporting (quaterly)	4	EA	1.00	$8,500.00	$8,500.00	$0.00	$0.00	$0.00	$0.00	$8,500.00	$34,000.00	1.25	1.18	$48,620	15%	8%	$60,400	P	N/A	
														Total Unit Cost			**$540,400**			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "D" PPE. An HPF of 0.95 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY	quantity
LS	lump sum
EQUIP	equipment
MATL	material
HPF	HTRW productivity factor
ADJ LABOR	adjusted labor for HFP
ADJ EQUIP	adjusted equipment for HFP
UNMOD UC	unmodified unit cost
UNMOD LIC	unmodified line item cost
EF	escalation factor
AF	area factor
UNBUR LIC	unburdened line item cost
PC OH	prime contractor overhead
PC PF	prime contractor profit
BUR LIC	burdened line item cost

Table A-4

CW-11 O&M Costs

Site:	**Omega Chemical**	Created by:	E. Borisova	Date:	26-Sep-07
Location:	**Whittier, California**	Checked by:		Date:	
Base Year:	**2008**				
Date:	**May 7, 2008**				

O&M Cost Alternative 4 Year 0-1

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC	CITATION		COMMENTS
Treatment System Engineering and Complience reporting	80	HRS	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100.00	$8,000.00	1.25	1.18	$11,440	15%	8%	$14,200	V	N/A	
Treatment System O&M Labor	214	HRS	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100.00	$21,400.00	1.25	1.18	$30,602	15%	8%	$38,000	V	N/A	
Equipment maintenance (filter changeout, lubrication)	3	EA	1.00	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	$0.00	$5,000.00	$15,000.00	1.25	1.18	$21,450	15%	8%	$26,600	V	N/A	
Blower Maintenance	4	EA	1.00	$0.00	$0.00	$4,500.00	$4,500.00	$0.00	$0.00	$4,500.00	$18,000.00	1.25	1.18	$25,740	15%	8%	$32,000	V	N/A	
Electricity Usage	14000000	kW	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.15	$2,100,000	1.25	1.18	$3,003,000	15%	8%	$3,729,700	V	N/A	
Instruments Rental	12	MONTH	1.00	$0.00	$0.00	$1,000.00	$1,000.00	$0.00	$0.00	$1,000.00	$12,000.00	1.25	1.18	$17,160	15%	8%	$21,300	V	N/A	
Vapor Carbon Disposal (sixteen changeouts @ 8000 lbs each)	128000	LBS	1.00	$0.00	$0.00	$0.00	$0.00	$2.00	$0.00	$2.00	$256,000.00	1.25	1.18	$366,080	15%	8%	$454,700	V	N/A	
SCAQMD Source Testing Third Party Firm	1	EA	1.00	$30,000.00	$30,000.00	$0.00	$0.00	$0.00	$0.00	$30,000.00	$30,000.00	1.25	1.18	$42,900	15%	8%	$53,300	V	N/A	
SCAQMD Source Testing Supervision	90	HRS	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100.00	$9,000.00	1.25	1.18	$12,870	15%	8%	$16,000	V	N/A	
Indor air monitoring program (sample collection at 8 bldg and QA/QC sampling collection, analizes, reporting, product use inventory)	1	LS	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$20,010	$20,010.00	$20,010.00	1.25	1.18	$28,614	15%	8%	$35,500	P	N/A	3 samples/bldg + 8QA/QC samples
SVE monitoring (inlet, intermediate and exhaust samples and QA/QC samples analyzed for EPA 8015M) by a Third-Party Firm. Assuming three samples first week and monthly thereafter.	73	samples	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$248.75	$248.75	$18,159.00	1.25	1.18	$25,967	15%	8%	$32,200	V	N/A	
Condensate/ Discharge sampling and Analysis	24	samples	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$294.29	$294.29	$7,063.00	1.25	1.18	$10,100	15%	8%	$12,500	V	N/A	
Engineering, Supervision, and Reporting (monthly)	12	EA	1.00	$8,500.00	$8,500.00	$0.00	$0.00	$0.00	$0.00	$8,500.00	$102,000.00	1.25	1.18	$145,860	15%	8%	$181,200	V	N/A	
														Total Unit Cost			**$4,647,200**			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "D" PPE. An HPF of 0.95 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY quantity
EQUIP equipment
MATL material
HPF HTRW productivity factor
ADJ LABOR adjusted labor for HFP
ADJ EQUIP adjusted equipment for HFP
UNMOD UC unmodified unit cost
UNMOD LIC unmodified line item cost
EF escalation factor
AF area factor
UNBUR LIC unburdened line item cost
PC OH prime contractor overhead
PC PF prime contractor profit
BUR LIC burdened line item cost
LS lump sum

CW-12: IC

UNIT COST DETERMINATION

Five Year Review

Created by: E. Borisova Date:
Checked by: Date:

Site: Omega Chemical
Location: Whittier, California
Phase: FS (+30/-50%)
Base Year: 2008
Date: May 7, 2008

Institutional Controls Package

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Staff Engineer for IC package	120	hr	1.00	$65.00	$65.00	$0.00	$0.00	$0.00	$0.00	$65	$7,800	1.25	1.18	$11,154	15%	8%	$13,900	P	N/A	
Legal Review	40	hr	1.00	$200.00	$200.00	$0.00	$0.00	$0.00	$0.00	$200	$8,000	1.25	1.18	$11,440	15%	8%	$14,200	P	N/A	
														Total Unit Cost			$28,100			

IC Package updates

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Staff Engineer for UC package Updates	80	hr	1.00	$65.00	$65.00	$0.00	$0.00	$0.00	$0.00	$65	$5,200	1.25	1.18	$7,436	15%	8%	$9,200	P	N/A	
														Total Unit Cost			$9,200			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY quantity
LS lump sum
EQUIP equipment
MATL material
HPF HTRW productivity factor
ADJ LABOR adjusted labor for HFP
ADJ EQUIP adjusted equipment for HFP
UNMOD UC unmodified unit cost
UNMOD LIC unmodified line item cost
EF escalation factor
AF area factor
UNBUR LIC unburdened line item cost
PC OH prime contractor overhead
PC PF prime contractor profit

CW-13: DPE contingency

Site:	Omega Chemical	Created by:	E. Borisova	Date:	26-Sep-07
Location:	Whittier, California	Checked by:		Date:	
Base Year:	2008				
Date:	May 7, 2008				

DPE Wells 25 wells (85 ft bgs) 25 wells

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Drill and install 4 inch vapor wells	1566	LF	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$80.00	$80.00	$125,280.00	1.25	1.18	$179,150 40	15%	8%	$222,505	P	N/A	bore hole 2 feet longer than well depth
Concrete Coring and cutting	36	HR	0.95	$125.00	$131.58	$11.14	$11.73	$0.00	$0.00	$143.31	$5,158.99	1.25	1 18	$7,377.35	15%	8%	$9,163	P	N/A	
Flush mounted surface completions	18	EA	0.95	$0.00	$0.00	$0.00	$0 00	$0.00	$200.00	$200.00	$3,600.00	1.25	1 18	$5,148.00	15%	8%	$6,394	P	N/A	
Containment drums for decon water	18	EA	0.95	$0.00	$0.00	$0.00	$0 00	$0.00	$42.00	$42.00	$756.00	1.25	1.18	$1,081.08	15%	8%	$1,343	P	N/A	
Decontamination trailer rental	4.5	DAY	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$150.00	$150.00	$675 00	1.25	1.18	$965.25	15%	8%	$1,199	P	N/A	
Forklift and dumpster	4.5	DAY	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$320.00	$320.00	$1,440.00	1.25	1.18	$2,059.20	15%	8%	$2,558	P	N/A	
2 inch PVC pipe for groundwater extraction	1566	LF	0.95	$2.01	$2 12	$4.06	$4.27	$1.01	$0.00	$7.40	$11,587.58	1.25	1.18	$16,570.23	15%	8%	$20,580	P	N/A	
4 inch submersible pump 0.3 - 7 gpm	18	EA	0.95	$4.00	$4.21	$0.00	$0.00	$2,118.00	$0.00	$2,122.21	$38,199.79	1.25	1.18	$54,625.70	15%	8%	$67,845	E	33-23-0523	Includes controls, up to 241 ft head
Well Vault, Traffic Loading, 4' by 4' SS	18	EA	0.95	$715.83	$753.51	$1,253.00	$1,318.95	$831.69	$0.00	$2,904.14	$52,274.57	1.25	1.18	$74,752.63	15%	8%	$92,843	P	N/A	1 per well
Non-Hazardous Disposal of Cuttings	180	EA	0.95	$0.00	$0.00	$0.00	$0.00	$88.50	$0.00	$88.50	$15,930.00	1.25	1.18	$22,779.90	15%	8%	$28,293	E	33-19-7205	Cost per drum, assume 9 per well
Blower Skid																				
Blower 1600 scfm 15" Hg	1	EA	1.00	$0.00	$0.00	$57,000.00	$57,000.0	$0 00	$0.00	$57,000.00	$57,000	1.00	1.00	$57,000	15%	8%	$70,800	P	N/A	
Pump Package	1	EA	1.00	$0.00	$0.00	$2,200.00	$2,200.00	$0.00	$0.00	$2,200.00	$2,200	1.00	1.00	$2,200	15%	8%	$2,700	P	N/A	
Heat Exchanger	1	EA	1.00	$0.00	$0.00	$11,000.00	$11,000.00	$0.00	$0.00	$11,000.00	$11,000	1.00	1 00	$11,000	15%	8%	$13,700	P	N/A	
Air/Water Separator	1	EA	1.00	$0.00	$0.00	$11,000.00	$11,000.00	$0.00	$0.00	$11,000.00	$11,000	1.00	1.00	$11,000	15%	8%	$13,700	P	N/A	
Noise Enclosure	1	EA	1 00	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	$0.00	$5,000.00	$5,000	1.00	1.00	$5,000	15%	8%	$6,200	P	N/A	
Control Panel	1	EA	1.00	$0.00	$0.00	$18,000.00	$18,000.00	$0.00	$0.00	$18,000.00	$18,000	1.00	1.00	$18,000	15%	8%	$22,400	P	N/A	
Skid Utilities/Electrical	1	EA	1.00	$0.00	$0.00	$25,000.00	$25,000.00	$0.00	$0.00	$25,000.00	$25,000	1.00	1.00	$25,000	15%	8%	$31,100	P	N/A	
Piping, Instrumentation and Misc.	1	EA	1.00	$0.00	$0.00	$25,000.00	$25,000.00	$0.00	$0.00	$25,000.00	$25,000	1.00	1.00	$25,000	15%	8%	$31,100	P	N/A	
Labor/Installation	1	EA	1.00	$3,000.00	$3,000.00	$0.00	$0.00	$0.00	$0.00	$3,000.00	$3,000	1.00	1.00	$3,000	15%	8%	$3,700	P	N/A	
VGAC Skid																				
Carbon Vessels	1	EA	1.00	$0.00	$0.00	$18,000.00	$18,000.00	$0.00	$0.00	$18,000.00	$18,000	1.00	1.00	$18,000	15%	8%	$22,400	P	N/A	
Lead/Lag Piping Manifold	1	EA	1.00	$0.00	$0.00	$15,000.00	$15,000.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
Virgin Carbon	8000	LBS	1.00	$0.00	$0.00	$0.00	$0.00	$2.00	$0.00	$2.00	$16,000	1.00	1.00	$16,000	15%	8%	$19,900	P	N/A	
Labor/Installation	1	EA	1.00	$2,500.00	$2,500.00	$0.00	$0.00	$0.00	$0.00	$2,500.00	$2,500	1.00	1.00	$2,500	15%	8%	$3,100	P	N/A	
Electrical Power Distribution																				
Electrical Service	1	EA	1.00	$30,000.00	$30,000.00	$0.00	$0.00	$0.00	$0.00	$30,000.00	$30,000	1.00	1.00	$30,000	15%	8%	$37,300	P	N/A	
Power Distribution to process equipment	1	EA	1.00	$15,000.00	$15,000.00	$0.00	$0.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
I&C and programming	1	EA	1.00	$15,000.00	$15,000.00	$10,000.00	$0.00	$0.00	$0.00	$15,000.00	$15,000	1.00	1.00	$15,000	15%	8%	$18,600	P	N/A	
Delivery/Start Up																				
Price to site	1	EA	1.00	$8,000.00	$8,000.00	$0.00	$0.00	$0.00	$0.00	$8,000.00	$8,000	1.00	1.00	$8,000	15%	8%	$9,900	P	N/A	
Start Up Assistance	1	EA	1.00	$13,000.00	$13,000.00	$0.00	$0.00	$0.00	$0.00	$13,000.00	$13,000	1.00	1.00	$13,000	15%	8%	$16,100	P	N/A	
Piping																				
6" diameter vapor pipe	750	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$42	$49	$37,059	1.25	1.18	$52,994	15%	8%	$65,800	P	N/A	Cost based on 6 inch fiberglass cost .
2" diameter liquid pipe	750	LF	0.85	$0.00	$0.00	$0.00	$0 00	$0.00	$11	$13	$9,706	1.25	1.18	$13,879	15%	8%	$17,238	E	19010203	Cost based on 2 inch PVC pipe. Assume
														TOTAL UNIT COST:			$895,700			
Contingency (scope and bid)				20%						$179,100										
														TOTAL CAPITAL COST:			$1,074,800			

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Equipment maintenance (filter changeout, lubricatio	1	EA	1.00	$0.00	$0.00	$5,000.00	$5,000.00	$0.00	$0.00	$5,000.00	$5,000.00	1.25	1.18	$7,150	15%	8%	$8,900	P	N/A	
Blower Maintenance	1	EA	1.00	$0.00	$0.00	$4,500.00	$4,500.00	$0.00	$0.00	$4,500.00	$4,500.00	1.25	1.18	$6,435	15%	8%	$8,000	P	N/A	
Electricity Usage	259200	KW	1.00	$0.00	$0.00	$0.00	$0.00	$0.12	$0.00	$0.12	$31,104.00	1.25	1.18	$44,479	15%	8%	$55,200	P	N/A	
Instruments Rental	12	MONTH	1.00	$0.00	$0.00	$1,000.00	$1,000.00	$0.00	$0.00	$1,000.00	$12,000.00	1.25	1.18	$17,160	15%	8%	$21,300	P	N/A	
Vapor Carbon Disposal	16000	LBS	1.00	$0.00	$0.00	$0.00	$0.00	$2.00	$0.00	$2.00	$32,000.00	1.25	1.18	$45,760	15%	8%	$56,800	P	N/A	
SCAQMD Source Testing Third Party Firm	1	EA	1.00	$30,000.00	$30,000.00	$0.00	$0.00	$0.00	$0.00	$30,000.00	$30,000.00	1.25	1.18	$42,900	15%	8%	$53,300	P	N/A	
SCAQMD Source Testing Supervision	10	HRS	1.00	$100.00	$100.00	$0.00	$0.00	$0.00	$0.00	$100.00	$1,000.00	1.25	1.18	$1,430	15%	8%	$1,800	P	N/A	
Monitoring	12	MONTH	1.00	$0.00	$0.00	$0.00	$0.00	$980.00	$0.00	$350.00	$4,200.00	1.25	1.18	$6,006	15%	8%	$7,400	P	N/A	SVE monitoring (inlet, intermediate and exhaust samples and QA/QC samples analyzed for EPA 8015M) by a Third-Party Firm. Assuming three samples first week and monthly thereafter.
Groundwater Treatment	11	MONTH	1.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7,920.00	$7,920.00	$87,120.00	1.00	1.00	$87,120.00			$87,120	P	N/A	
														TOTAL UNIT COST:			$299,800			
Contingency (scope and bid)				20%						$60,000										
														SUBTOTAL O&M COST:			$359,800			
Project Management				10%													$36,000			
Technical Support				15%													$54,000			
														TOTAL O&M COST			$449,800			

Notes:

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543

Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp

HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:

NA - Not Applicable - costs are from previous work or vendor quote

For citation references, the following sources apply:

E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote

L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "D" PPE. An HPF of 0.95 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes.
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY	quantity
EQUIP	equipment
MATL	material
HPF	HTRW productivity factor
ADJ LABOR	adjusted labor for HFP
ADJ EQUIP	adjusted equipment for HFP
UNMOD UC	unmodified unit cost
UNMOD LIC	unmodified line item cost
EF	escalation factor
AF	area factor
UNBUR LIC	unburdened line item cost
PC OH	prime contractor overhead
PC PF	prime contractor profit
BUR LIC	burdened line item cost
LS	lump sum

CW-14: Hot air injection contingency

Site:	**Omega Chemical**	Created by:	E. Borisova	Date:	26-Sep-07
Location:	**Whittier, California**	Checked by:		Date:	
Base Year:	**2008**				
Date:	**May 7, 2008**				

Injection Wells

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Drill and install shallow injection wells	12	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$0	$1,652	$19,821	1.00	1.00	$19,821.18	15%	8%	$24,600	P	N/A	PVC wells
Drill and install deep injection wells	6	EA	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$0	$4,711	$28,264	1.00	1.00	$28,263.53	15%	8%	$35,100	P	N/A	PVC wells
Concrete Coring and cutting	18	HR	0.95	$125.00	$131.58	$11.14	$11.73	$0.00	$0.00	$143.31	$2,579.49	1.25	1.18	$3,688.68	15%	8%	$4,581	P	N/A	
Flush mounted surface completions	18	EA	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$200.00	$200.00	$3,600.00	1.25	1.18	$5,148.00	15%	8%	$6,394	P	N/A	
Containment drums for decon water	18	EA	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$42.00	$42.00	$756.00	1.25	1.18	$1,081.08	15%	8%	$1,343	P	N/A	
Decontamination trailer rental	4.5	DAY	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$150.00	$150.00	$675.00	1.25	1.18	$965.25	15%	8%	$1,199	P	N/A	
Forklift and dumpster	4.5	DAY	0.95	$0.00	$0.00	$0.00	$0.00	$0.00	$320.00	$320.00	$1,440.00	1.25	1.18	$2,059.20	15%	8%	$2,558	P	N/A	
Well Vault, Traffic Loading, 4' by 4' SS	18	EA	0.85	$180.00	$211.76	$0.00	$0.00	$2,100.00	$0.00	$2,312	$41,612	1.00	1.00	$41,600	15%	8%	$51,700	P	N/A	1 per well
Non-Hazardous Disposal of Cuttings	36	EA	0.95	$0.00	$0.00	$0.00	$0.00	$88.50	$0.00	$88.50	$3,186.00	1.25	1.18	$4,555.98	15%	8%	$5,659	E	33-19-7205	Cost per drum, assume 9 per well
Blower Skid																				
Blower 300 acfm 20" Hg	2	EA	1.00	$0.00	$0.00	$13,000.00	$13,000.00	$0.00	$0.00	$13,000.00	$26,000.00	1.00	1.00	$26,000.00	15%	8%	$32,292	P	N/A	no additional heating will be required
Pump Package	2	EA	1.00	$0.00	$0.00	$1,650.00	$1,650.00	$0.00	$0.00	$1,650.00	$3,300.00	1.00	1.00	$3,300.00	15%	8%	$4,099	P	N/A	
Air/water separator	2	EA	1.00	$0.00	$0.00	$6,750.00	$6,750.00	$0.00	$0.00	$6,750.00	$13,500.00	1.00	1.00	$13,500.00	15%	8%	$16,767	P	N/A	
Piping, Instrumentation and Misc.	1	EA	1.00	$0.00	$0.00	$5,000.00	$5,000.00	$2,500.00	$0.00	$7,500.00	$7,500.00	1.00	1.00	$7,500.00	15%	8%	$9,315	P	N/A	
Control Panel	1	EA	1.00	$0.00	$0.00	$7,500.00	$7,500.00	$0.00	$0.00	$7,500.00	$7,500.00	1.00	1.00	$7,500.00	15%	8%	$9,315	P	N/A	
Labor/Installation	1	EA	1.00	$20,000.00	$20,000.00	$0.00	$0.00	$0.00	$0.00	$20,000.00	$20,000.00	1.00	1.00	$20,000.00	15%	8%	$24,840	P	N/A	
Skid Utilities/Electrical	1	EA	1.00	$0.00	$0.00	$8,000.00	$8,000.00	$0.00	$0.00	$8,000.00	$8,000.00	1.00	1.00	$8,000.00	15%	8%	$9,936	P	N/A	
Trailer	1	EA	1.00	$0.00	$0.00	$10,000.00	$10,000.00	$0.00	$0.00	$10,000.00	$10,000.00	1.00	1.00	$10,000.00	15%	8%	$12,420	P	N/A	
Delivery/Start Up																				
Price to site	1	EA	1.00	$1,500.00	$1,500.00	$0.00	$0.00	$0.00	$0.00	$1,500.00	$1,500	1.00	1.00	$1,500	15%	8%	$1,900	P	N/A	
Start Up Assistance	1	EA	1.00	$2,500.00	$2,500.00	$0.00	$0.00	$0.00	$0.00	$2,500.00	$2,500	1.00	1.00	$2,500	15%	8%	$3,100	P	N/A	
Piping																				
6" diameter pipe	1000	LF	0.85	$0.00	$0.00	$0.00	$0.00	$0.00	$42	$49	$49,412	1.25	1.18	$70,659	15%	8%	$87,800	P	N/A	Cost based on 6 inch fiberglass cost .
Pipe insulation	1000	LF	0.85	$4.01	$4.72	$0.00	$0.00	$3.56	$42	$59	$59,150	1.25	1.18	$84,585	15%	8%	$105,100	C	02091-330-1060	Cost based on 6 inch fiberglass cost .

		TOTAL UNIT COST:	**$450,000**
Contingency (scope and bid)	20%		$90,000
		SUBTOTAL	**$540,000**
Project Management	10%		$54,000
Technical Support	15%		$81,000
		TOTAL CAPITAL COST	**$675,000**

O&M Cost

DESCRIPTION	QTY	UNIT(S)	HTRW	LABOR	ADJ LABOR	EQUIP	ADJ EQUIP	MATL	OTHER	UNMOD UC	UNMOD LIC	EF	AF	UNBUR LIC	PC OH	PC PF	BUR LIC		CITATION	COMMENTS
Blower Maintenance	1	EA	1.00	$0.00	$0.00	$2,000.00	$2,000.00	$0.00	$0.00	$2,000.00	$2,000.00	1.00	1.00	$2,000.00	15%	8%	$2,484	P	N/A	
Electricity Usage	12	MONTH	1.00	$0.00	$0.00	$0.00	$0.00	$2,000.00	$0.00	$2,000.00	$24,000.00	1.00	1.00	$24,000.00	15%	8%	$29,808	P	N/A	

		TOTAL UNIT COST:	**$32,300**
Contingency (scope and bid)	20%		$6,500
		SUBTOTAL	**$38,800**
Project Management	10%		$3,900
Technical Support	15%		$5,800
		TOTAL O&M COST	**$48,500**

Notes:

PRESENT VALUE ANALYSIS

COST TYPE	YEAR(S)	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)**	PRESENT VALUE	Comments
Capital Costs	0	$675,000	1	$675,000	
Annual Costs	1	$48,500	0.935	$45,300	
	2- 5	$48,500	3.166	$153,500	

Area factor is from Exhibit B-2 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Escalation factor is index from base year of estimate divided by index from year of cost data. Base is 2000 and new cost index is from October 2006. 4431/3543
Escalation indices are from Exhibit B-1 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, and http://www.enr.com/cost/costbci.asp
HTRW productivity factor is from Exhibit B-3 or B-4 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000

Source of Cost Data:
NA - Not Applicable - costs are from previous work or vendor quote
For citation references, the following sources apply:
E - ECHOS Unit Cost Book 2000; C - Means CostWorks 2000; P - Based on Previous Work by CDM Federal; V - Vendor Quote
L - Average Professional Labor Rates for 2002 (Average Rates Compiled from Various State/Federal Public Contract Sources)

Cost Adjustment Checklist:

FACTOR:	NOTES:
H&S Productivity (labor and equipment only)	Field work will be in Level "D" PPE. An HPF of 0.95 is used for labor and equipment unit costs that occur in contaminated areas.
Area Cost Factor	An AF of 1.18 is used for California, except an AF of 1.00 (national unmodified average) is used for local vendor quotes
Subcontractor Overhead and Profit	It is assumed that Subcontractor O&P is either included in the PC O&P or has been factored into vendor quotes or previous work.
Prime Contractor Overhead and Profit	It is assumed that home office OH is 5%, and field office OH is 10%. Profit of 8% is used for the Prime Contractor.

Abbreviations:

QTY quantity
LS lump sum
EQUIP equipment
MATL material
HPF HTRW productivity factor
ADJ LABOR adjusted labor for HFP
ADJ EQUIP adjusted equipment for HFP
UNMOD UC unmodified unit cost
UNMOD LIC unmodified line item cost
EF escalation factor
AF area factor
UNBUR LIC unburdened line item cost
PC OH prime contractor overhead
PC PF prime contractor profit
BUR LIC burdened line item cost

CDM

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